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Valve Firm Operates Four Shops—I

Gray Iron Foundry and the Older Brass Shop Described—Hydrant Standpipes Made with Nine Green Sand Cores—Alloys Melted in Open-Flame and in 16 Crucible Furnaces

FUNDAMENTALLY, sheer love of achievement for its own sake, the pitting of skill and intellect against competitive forces, rather than love of money, is the motive responsible for success in business. Incidentally, success insures a monetary competence and in many cases is synonymous with the possession of huge fortunes for those who reach the peak of their ambition. Formerly when many forms of business were conducted on a much smaller scale than in these later years, it was not uncommon for a skilled artisan to carry on manufacturing in his own home or in a convenient building in the immediate vicinity. He taught his sons the trade and in the event that he had other apprentices they lived in the house of their master. The proprietor critically examined the work of his associates and subordinates and assured himself that anything bearing his shop mark would not detract from his legitimate pride as a craftsman. After he had served his allotted span of years and had been gathered to his fathers, his sons carried on the business and perpetuated his policies and standards. In many instances particularly in European countries, specific lines of manufacture have been transmitted from father to son for generations.

The majority of large enterprises, particularly at the present day, due to one cause or another, are officered and directed by men who are in no way related to the men who laid the foundations. However, exceptions exist to this, as to every other general rule and a number of prominent firms still are controlled by the families of the original founders. In the foundry field, the Kennedy Valve

FIG. 1—MOLDS FOR 10-INCH GATE VALVES ARE MADE ON STRIPPING PLATE MACHINES, EITHER HAND RAMMED OR JAR RAMMED FIG. 2—METAL IS CARRIED FROM THE CUPOLAS ON A TROLLEY SYSTEM WHICH ALSO SERVES TO TRANSFER FACING SAND TO THE MOLDERS

FIG. 3—LARGE ROUND CORES ARE HELD BY THE PRINTS BETWEEN THE COPE AND DRAG FLASKS

Mfg. Co., Elmira, N. Y., furnishes an interesting case in point. Daniel Kennedy founded the business in New York City in 1877, moved in 1890 to Coxsackie, a small town on the Hudson River & West Shore railroad, south of Albany and the last move was made in 1907 when the plant was established in Elmira, N. Y. He still retains the presidency of the company officered and managed by his sons, which operates gray-iron, malleable-iron and brass foundries, besides extensive machine shops.

The main plant is located on a 20-acre plot of ground on the north side of East Water street, just outside the city limits on a paved road leading to Binghampton. The malleable foundry, originally built by the American Bridge Co., and only recently purchased by the Kennedy Valve Mfg. Co., is located on a large plot of land comprising 15 acres on East Miller street, nearly two miles away from the other group of shops operated by the company.

Ample railroad facilities was one of the advantages which induced the Kennedy company to move to Elmira. The city is served by the Delaware, Lackawanna & Western, the Erie, the Pennsylvania, and the Lehigh Valley railroads. The main plant is situated on the Delaware, Lackawanna & Western railroad, while the malleable plant is connected by spurs to both the Erie and the Pennsylvania roads. Of course, both shops have switching service to the roads with which they are not directly connected. The location which is central for shipping in the east also is located close to supplies of coal and iron.

The older foundries, the gray-iron shop, and one of the brass foundries will be described first. The gray-iron shop is a long narrow building with a double monitor roof extending the entire length of the building and furnishing ventilation, and additional light in the center of the shop. The foundry proper is 100 x 300 feet and the cleaning department adds a section 60 x 100 feet. The core room is in the end of the building opposite the one occupied by the cleaning room.

As the name of the company would imply valves, hydrants, standpipes and kindred castings form the main products. Before describing the foundry the molding operations peculiar to this class of work will be cited. Fig. 1 shows the mold for a 10-inch gate valve. The heavy core may be noted on the drag of the open mold. These cores are made of a mixture 2/3 old sand and 1/3 new Millville gravel bonded with black pitch or other dry binder in the ratio of 1 to 80. Smaller cores vary from this mixture, being made of beach sand, molding sand and a smaller amount of old sand with a greater proportion of binder. At the rectangular end, the core is held firmly in the mold by the wide print, but the other end of the core has only a small bearing in the mold, and must be supported and held by one stem chaplet in the cope and another in the drag. Before the mold is closed, a templet is employed to determine the position of the core.

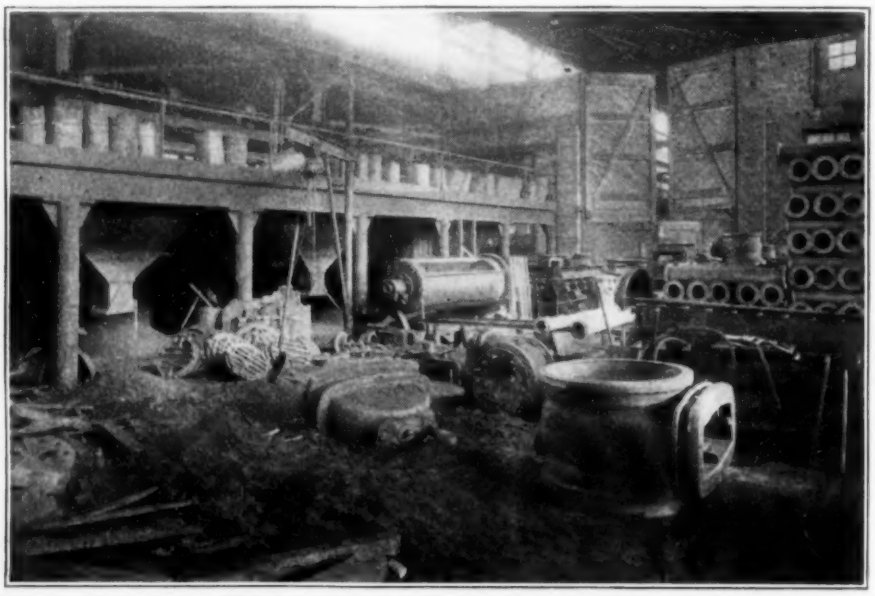


FIG. 4—SMALLER CASTINGS ARE CARRIED BY THE CRANE TO A PLATFORM AND DUMPED FROM HERE TO THE TUMBLING BARRELS

Cope and Drag on Same Machine

The cope and drag, identical except for the gates, risers and runners, are made on the same machine. Short orders are made on a hand-ram stripping-plate machine while the pattern is fitted on a jar-ram stripping-plate machine for longer runs. With the hand-ram machine a molder and helper make 30 molds a day while with the jar-ram machine these men will put up 40 molds in a day. A strainer core is used in the down gate and a 1-inch riser is placed on the flange.

The molds for a 20-inch hub body for a waterworks gate valve, as shown in Fig. 3 represent a somewhat different type of molding from that employed for the gate-valve mold already described. The large core is anchored by prints held firmly between the cope and drag. The drag

section of this core is built on an iron arbor formed of wings which slip on a central beam, and the cope half is pasted on top, the two halves also are held together by the mold which clamps around the prints at both ends. The molds are jolted on a machine with a 60 x 70-inch plate, then blacked, using a machine built by the J. S. McCormick Co., Pittsburgh, and skin dried with an oil torch. The cope and drag are made from the same pattern and their positions on the pattern board are located by guide-pin holes accurately drilled on both sides of the flask. the bottom plate is laid on and clamped to the flask. Three of the clamps may be seen on the mold in the foreground in Fig. 5. Bars in the cope flask prevent the sand from falling out.

The long, slim core is made of green sand in a hinged corebox. An arbor consisting of a cast-iron bar with wings is used in the drag. End plates *A*, Fig. 5 wedged to the end of this arbor serve as bearings in the mold, being held between the cope and the drag flasks. A semicircular dry-sand core, *B*, Fig. 5, is laid on the cope corebox before the sand is rammed the core set, and behind this a flask closed but without the pouring basin. A piece of paper is laid over the gate holes to prevent dirt from falling in. At each end of this flask may be noted the mounds of sand around the riser holes which are formed on each end of the mold.

Besides the two special machines used for molding the hydrant standpipe castings, the company uses 10 pattern-draw, air-squeeze machines made by the Tabor Mfg. Co., Philadelphia, and eight of the same type made by the Hanna Engineering Works, Chicago; also 10 homemade

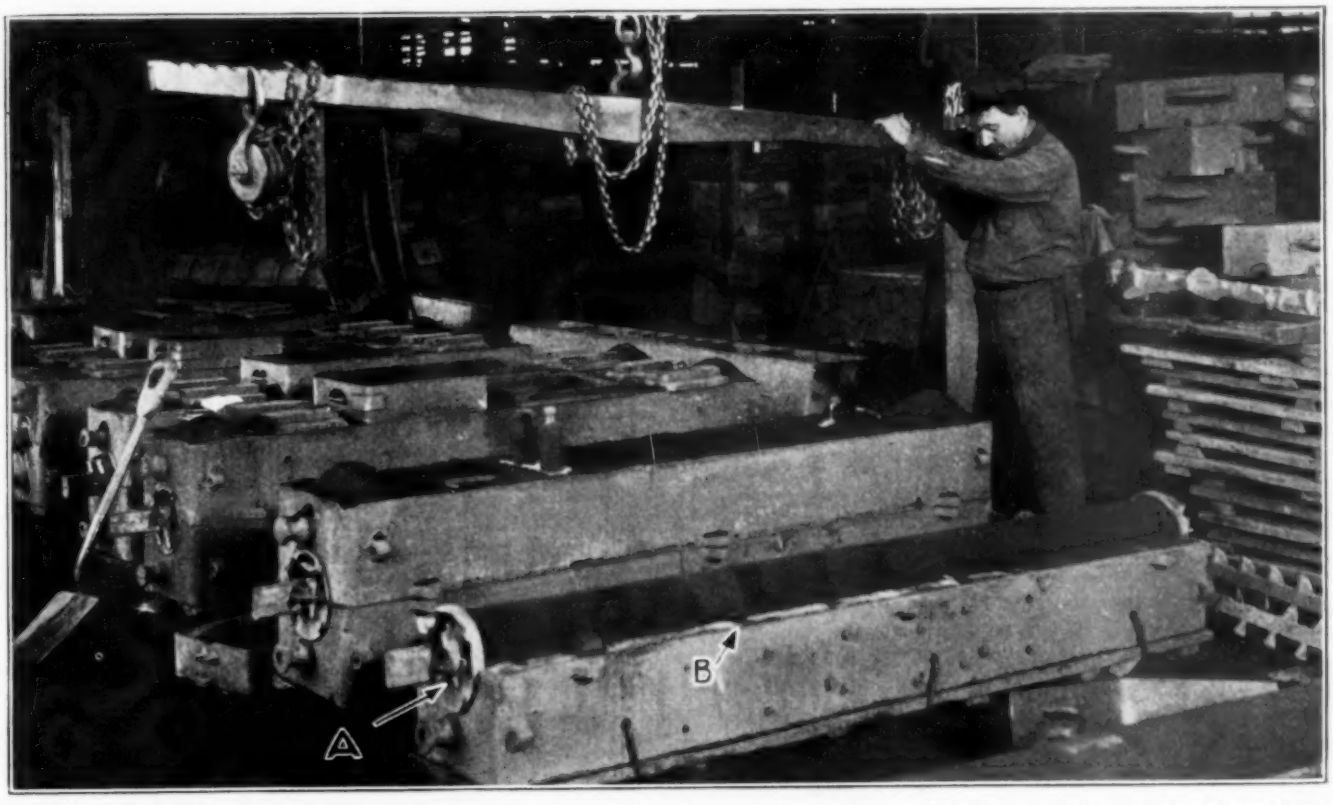


FIG. 5—HYDRANT STANDPIPE CASTINGS ARE POURED FROM A RUNNER BOX WITH TWO DOWN GATES THE METAL FALLS ON A SMALL DRY-SAND CORE MOLDED IN THE MAIN CORE WHICH IS GREEN SAND

The iron is poured through a pouring basin on one side, with two down gates. The iron enters the mold from two runners at the junction of the cope and drag. Strainer gates help to insure clean metal in the casting and a riser on the side opposite the pouring basin assists in feeding metal to the casting as it sets.

Hydrant standpipes illustrate another type of molding in this shop. They are made in long narrow cast-iron flasks on a hand-ram stripping-plate machine. The largest section is 7 inches inside diameter and 8 inches outside diameter, thus having a ½-inch wall by 6½ feet long over all. The drag and the cope are made on the same machine. After the drag is rammed and struck off and serves to break the fall of the metal poured from a basin with two down gates immediately above this ram-up core. After the two halves of the core are brought together by raising both sides and thus closing the hinged corebox, it is rolled on wooden horses, so that the drag side is down. The cope box then can be swung to the side and the core lifted off by the I-beam traveling crane which serves this floor.

The yoke for lifting the cores, molds and castings may be seen in Fig. 5. Chains which hang from each end of the yoke engage trunnions on the flask. The distance between the chains is regulated by notches on the bar of the yoke. The same illustration shows in the foreground a drag with stripping-plate hand-ram machines. The larger work is made on 6 jar-ram machines furnished by the Herman Pneumatic Machine Co., Pittsburgh. Three of these machines are arranged for power draw.

The core room is located at one end of the shop and is equipped with six car-type coke-fired ovens and two drawer-type ovens for the smaller cores. Girls and men do not work together in this department or in any of the core rooms in the Kennedy company's foundries. The sand is wheeled in from the stock bay in barrows, and is mixed by an electric riddle.

Sand, coke and pig iron are unloaded in the stock yard by a traveling crane operating on a 150-foot run-

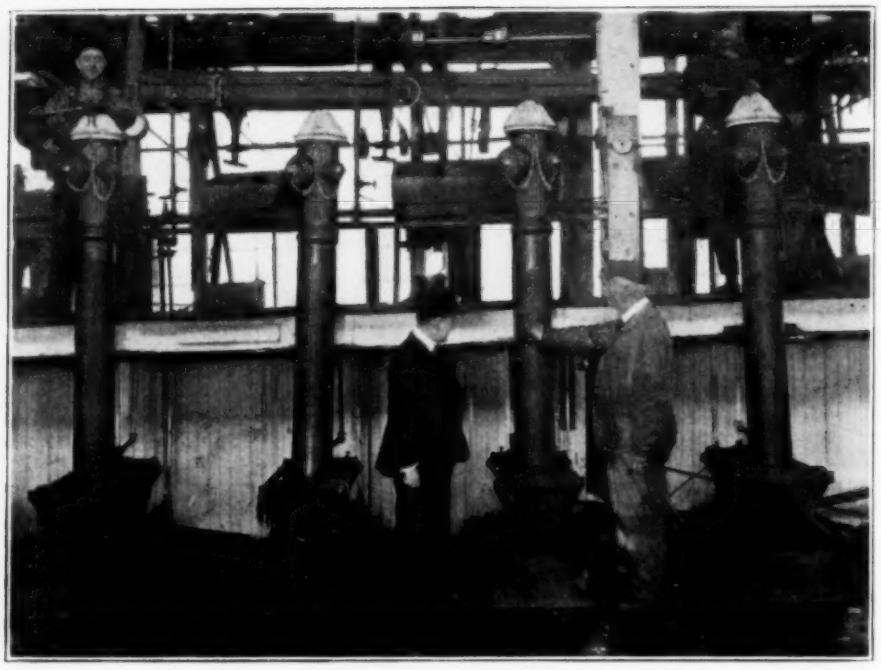


FIG. 6—SET OF CASTINGS ARE TESTED UNDER WATER PRESSURE AFTER THE HYDRANT IS ASSEMBLED

way with an 80-foot span, using a magnet for handling the pig iron and a grab bucket for transferring the sand and coke. Of course, to handle the material in this way it must be received in open cars. Both coke and sand are dumped for storage through openings in the roof of sheds provided for the purpose. Materials for charging the cupolas are lifted to an extended platform adjoining the cupola charging room, and the charges are weighed on skids which are transferred to the cupolas by a hand-lift truck. The two cupolas, lined to 54 and 36 inches diameter, respectively, built by the Whiting Corp., Harvey, Ill., are charged by hand. As a precaution against delay from break-down a narrow-gage track has been laid through the stock yard connected by a turntable to the elevator leading to the cupola charging platform. Thus, two ways of getting the stock to the cupolas are available. The narrow-gage track also serves to bring materials into the foundry and carry flasks to the storage yard.

Pig iron, as it is received, is divided into two classifications according to its silicon contents. The 4000-pound charge, used on the larger cupola which is employed almost entirely, the smaller supola being held in reserve, is made up of 2000 pounds of the two grades of pig iron designated *A* and *B*. The remainder of the charge consists of 10 per cent steel scrap, usually in the form of fish plates, and 40 per cent gray-iron scrap. The cupola is well slagged, about 45 pounds of limestone and 30 pounds of fluor spar being used on a charge.

Metal is caught from the cupola in a receiving ladle and transferred to ladles carried on an I-beam trolley system which forms a loop around the shop, extending over the aisles located along the two sides of the center bay. Metal is carried in 1000 and 1500-pound ladles along this continuous track and switched to side bays equipped with pouring equipment consisting of a ladle operated by a lever and rack suspended from a trolley riding on an I-beam, manufactured by the Arcade Mfg. Co., Freeport, Ill. Molds in the center bay are poured by a somewhat similar pouring device built by the Modern Pouring Device Co., Port Washington, Wis., or by the traveling crane covering this bay. A beam for one of these cranes may be noted in Fig. 1.

Facing Sand on Trolley

Fig. 2 shows the front of the cupolas with the mixing ladle in place. It may be noted that a portion of the I-beam track is swung back at *A*. This allows the crane to set the ladle in place. The dump bucket, being pushed by the laborer, contains facing sand which is brought to the molders in this manner from the mixing room where it is mixed by electrically operated riddles. This illustration also shows one of the narrow-gage tracks which extend across the foundry and upon which many things are transferred, including flasks, to and from the flask yard.

The floors are cleaned at night. The sand is cut by a machine furnished by the American Foundry Equipment Co., N. Y. and the castings are carried to the cleaning room, either by the large traveling crane or by the trolley system. The larger castings are set on the floor where the core sand is taken out and the surface cleaned by manual labor. An exception to this is the hydrant-standpipe casting which is tumbled in a long barrel shown toward the center in Fig. 4. This illustration also shows

FIG. 7—THE MELTING EQUIPMENT IN THE OLD FOUNDRY CONSISTS OF TWO OPEN-FLAME FURNACES AND A NUMBER OF CRUCIBLE FURNACES

some of the larger valve castings, undergoing the cleaning process and, at the left, the platform on which the smaller castings are deposited. Here the sprues are knocked off and put into sheet-steel barrels to be carried to the cupola charging platform. The castings are dropped into tumblers at a lower elevation, and from there to the chipping and grinding department on the floor level. A magnetic separator built by the Dings Magnetic Separator Co., Milwaukee is employed for reclaiming small scrap.

The cleaning room adjoins the machine shop, separated only by a partition so arranged that the crane can pass over it and upper doors shown in Fig. 4 open to allow the crane to carry loads from one shop to the other. All castings are tested under hydraulic pressure near the end of the machine shop opposite the foundry. After they are machined and assembled the hydrant standpipes are tested in that section of the testing department shown in Fig. 6. Proud of its good name and the product for which it stands, the Kennedy Co., watches these tests closely. It insists on a higher standard of excellence than many of the distributors through whom the product is sold. Possibly one reason is that practically every casting or assembled unit carries an identification mark showing where it was made.

The reputation of the brass foundry as well as the gray-iron shop stand behind the product. The old brass foundry covers an area of 50 x 200 feet. The melting equipment consists of two Schwartz melting furnaces, each with a capacity of 500 pounds per heat; and 14 coke-fired pit furnaces, 10 of which hold No. 70, and 4 larger ones hold No. 125 crucibles. Oil and air enter the combustion chamber through pipes shown to the left of each of the Schwartz furnaces shown in Fig. 7. Metal is charged through the door shown open on the furnace to the left. After metal has been added to the furnace the door is closed and held by the clamp, and the furnace is rotated to the position for blowing as shown by the furnace at the right. Rotation is controlled by the large handwheel at the right on each furnace. The flame strikes the metal and passes out through a hole in the side of the furnace as indicated in the furnace at the right. As the flame is in direct contact with the metal this type furnace is known as an open-flame furnace. In contrast to this is the crucible furnace in which the metal is protected in a measure from the action of the flame. Crucibles

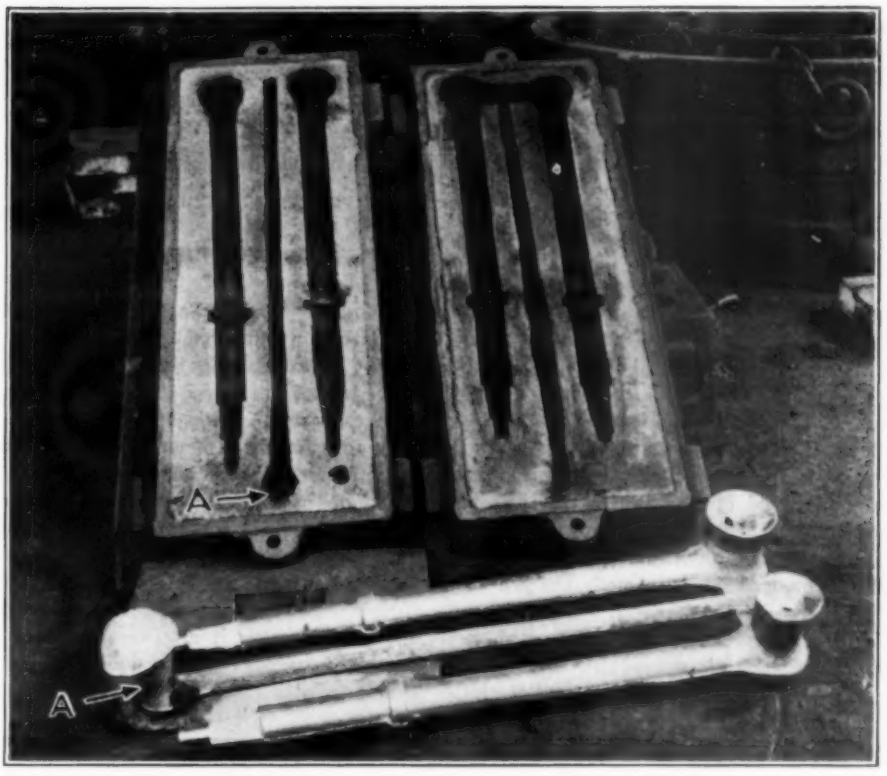


FIG. 8—MANGANESE BRONZE CASTINGS ARE MADE WITH HEAVY RISERS ON ACCOUNT OF THE SHRINKAGE OF THE METAL

are used by the Kennedy company mainly for melting manganese bronze and when only a small amount of any one alloy is desired.

The largest tonnage is cast in red brass, either 85 per cent copper, and 5 per cent each of tin, zinc and lead, generally known as 85-5-5-5; or, an alloy containing 86 per cent copper, 7 per cent tin, 4 per cent zinc and 3 per cent lead. The manganese bronze castings usually are made from a mixture of a standard make of ingot manganese bronze and scrap and sprue from the foundry. However, at times the Kennedy company makes its own manganese bronze. Castings of this metal often are made to specifications submitted by the purchaser as strength frequently is the prime requisite. One of the difficulties in casting is due to its high shrinkage. This is taken care of through gating and feeding. Fig. 8 shows a mold for two valve stems to be made of manganese bronze. The castings on the gate may be seen in the foreground. It may be noted that the metal is poured through down gate at *A* and passes through the runner to the other end of the mold where it enters the castings after having passed through a riser at the top of each casting. This riser is formed partly in the drag and partly in the cope and furnishes a comparatively large reservoir from which the shrinking metal in the casting may draw. An idea of the amount of shrinkage in the metal may be gained by noting the risers.

Metal is carried from the furnace at one end of the shop, to the molds, by a trolley system which extends through the center of the shop. From the trolley the metal is transferred to I-beam traveling cranes which cover each side of the shop. Attached to the cranes are ladles with the Brillion pouring device attached. Unlike the iron foundry where the metal is poured only in the afternoon, metal is coming from the crucibles or the oil-fired furnaces at frequent intervals throughout the entire day. The molder stops to pour the molds when the metal is brought to him, but a laborer dumps the castings and takes them to the cleaning room. Besides pouring the castings the molder also cuts his own sand. Working on this basis the average molder will put up 105 to 106 molds in a day, working on an air-squeeze machine of which the shop is equipped with 19, made by the Tabor Mfg. Co., the Hanna Engineering Works, and the Federal Malleable Co., West Allis, Wis.

Two water mills and a magnetic separator, the latter similar to the one used in the iron foundry, serve to recover metal from the refuse and separate the ferrous from the non-ferrous scrap. Castings are taken to the new brass foundry to be cleaned. This foundry will be described in the next issue of THE FOUNDRY, April 15

Sand Offers Field for Improvement

Many Factors Besides Physical Characteristics and Chemical Analysis Enter Into the Preparation, Classification and Grading of Sand Used in the Preparation of Molds in Which Metal is Poured

BY EUGENE W. SMITH

LITTLE definite information can be obtained from books or technical papers on the subject of sand for foundry use. This probably is due to the fact that each foundryman requires a material best suited to his equipment and the class of castings in which he specializes. Different methods of molding, whether on the floor, the bench, hand or machine rammed, require different grades of sand. Heavy and light castings, those which require a fine finish and others in which the finish is unimportant, also fall into different classifications. Steel, malleable iron, gray iron and brass, melted at different temperatures involve the use of sands possessing refractoriness in varying degrees. The relative porosity of the sand is an important factor in taking care of the gases generated under certain conditions. The silica content is the governing element, because broadly speaking as the silica content, or refractoriness, increases, the bond, represented by the clay or alumina content decreases and the foundryman's constant problem is to maintain these elements in their proper relative proportions. Sand employed to form deep pockets or close corners, manifestly must have a stronger bond than sand employed to form plain surfaces. The bond is controlled by the amount of alumina or iron oxides present and the predominance of either may be noted by the color; iron supplying the red and alumina, the yellow shades. Summing up the foregoing it may be stated that but two conditions are required: bond and porosity; and alumina and silica or in simpler words clay and sand. For example, lake sand, almost entirely silica, and clay used for making brick and tile, mainly alumina, must be blended in the proper proportion, since neither one alone, is suitable for molding purposes.

Other oxides present in sands appear to exert no particular influence. The presence of lime to any extent affects the finish on the face of the castings and therefore in many cases prohibits the use of otherwise satisfactory sand. The finished surface of the casting is determined by the texture or grain size of the sand employed to form the mold and the degree of fineness is determined by running the sand through a series of sieves, ranging from 10 to 100 meshes to the inch.

Good molding sands exist in almost every state of the union and this factor taken in connection with high freight rates accounts for the fact that foundries usually depend on a local sand supply. Sand deposits are found on the hill tops, the prairies and sometimes in deep banks in the hills with gravel pits below. On some Illinois farms it is spread in layers from 1 to 3 feet deep. After the top soil is removed the No. 1, or fine grade extends down, usually from 12 to 20 inches; No. 2, a little coarser grade, lies just below and No. 3, which is still coarser, lies on a strata or foundation of clay. In parts of Wisconsin, different grades of sand appear at the surface 100 to 500 feet apart and not in layers as in Illinois.

In some cases it is probable that certain grades of sand may be traced to glacial deposits. A continuous deposit of fine sand may be traced by drawing a line from the lower central part of Wisconsin, southeast, curving through central Illinois, central Indiana and northern Kentucky to the Virginias. Simply turning over the sod in some of the Kentucky hills exposes the finest grades of molding sand. Sands may be found along the territory outlined, equivalent to the French prepared sands and the equal if not the superior of the famous Albany sands, whose reputation dates from the days when all American foundries were located in the East. The sand was shipped by water down the Hudson river and along the Atlantic coast.

A prominent feature of all eastern sands is that they are high in silica, very open, and may be rammed quite hard without endangering the casting. Western sand under the same treatment would produce nothing but scrap. However, as a compensatory measure, eastern sand does not retain its bond as long as sand found in the west. A judicious mixture of eastern and western sand should prove an ideal combination, since each one possesses something in which the other is lacking, but the great distances in-

Samples of American Molding Sands

	Opener	Binders		Of no particular molding value				Texture and finish	
	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Alkalies	SO_2	Fineness	
Tennessee	92.96	3.10	4.92	....	....	0.26	....	98.58	Fine Weak Open
Long Island, N. Y.	89.16	2.92	4.66	....	0.33	0.33	....	0.53	Coarse Weak Open
New York	82.34	4.24	8.50	0.96	0.40	1.79	0.54	1.70	Coarse Strong Open
Indiana	82.50	2.70	8.90	0.16	0.61	1.47	....	0.50	Coarse Strong Open
Wisconsin	82.87	2.67	8.45	0.80	0.89	1.00	trace	57.3	Medium Strong Open
Indiana	79.66	9.74	3.36	1.34	0.68	2.50	....	78.34	Medium Strong Open
South Carolina	79.30	4.10	10.70	1.19	1.29	....	....	....	Strong Open
Kentucky	76.16	4.24	12.02	....	0.72	1.21	....	....	Open Fine Strong
Ohio	77.14	6.44	9.20	trace	0.91	1.10	....	....	Strong Open
Illinois	75.70	13.46	3.00	0.60	1.08	2.15	0.19	0.60	Coarse Strong Close
Illinois	56.80	5.09	14.43	6.40	5.60	3.15	0.14	70.24	Fine Strong Very close

From a paper presented at the March meeting of the Chicago Foundrymen's club. The author is connected with the Crane Co., Chicago, in the capacity of superintendent of foundries.

tervening, coupled with exorbitant freight rates, effectually prevents any consummation of that character.

No foundryman should limit himself to one grade of sand. At least two should be available, one high in bond, the other high in silica to be used in opening up sands when losses on the floor are due to *blows*, etc., and for facing purposes on heavier castings. The high bond sands are used in revivifying the heaps when the sand has been weakened from constant use, or other cause. Good molding sand often is condemned through ignorance of correct foundry practice. Excessive additions of new sand invariably will cause losses both of castings and sand. Where sand is too strong, or new, it burns on to the casting, thereby causing waste. Too much sea coal facing weakens the sand. After a short time the unburned portion of the coal in the sand will destroy the bond by coating each grain with carbon. The sand becomes a deep black, instead of red, the natural color of burned sand. The addition of new sand is required to overcome this condition.

Heavy castings burn the bond out of sand to a greater extent than do light ones and therefore more frequent renewal is necessary. Core sand falling into the heap while the castings are being removed weakens the sand by increasing the silica content and consequently it becomes necessary to neutralize the effect by adding new molding sand to the heap. Where the sand is not sufficiently knocked off the castings, the best portion, represented by riddled sand, is carried away and wasted. The common practice of pouring surplus metal into pig beds, or pools formed in the sand, is a source of waste both of sand and of the labor handling the metal. Small ingot molds should be provided for the purpose. Another common practice, at least in northern foundries, is to pour iron over new sand to thaw or dry it out; this wastes both metal and sand.

No Universal Standard

Sometimes a foundryman derives wonderful results from a certain grade of sand and as a result recommends it highly to another foundryman. The second man may be handling a much heavier line of castings, but if the sand presents a favorable appearance he orders a supply. When the bond burns out in a short time he realizes that one standard will not suit all classes of work. Intentionally omitting names and brands, the accompanying table shows variations in the component parts and composite fineness of sands taken at random from widely separated sand deposits. A study of the table will show the variation existing in all molding sand. The foundryman should be supplied with the analysis of every car of sand he buys and thus through familiarity, he eventually can establish standards to fit his particular requirements. Under the present crude practice of buying and selling molding sand, small spoonful samples are shown by the salesman. The prospective buyer squeezes the sample into a ball to test the bond and finish by *feel*. The real expert rubs it in close proximity to his ear to test its openness by *sound*. The only remaining test is to *taste* it. If the United States bureau of standards, universities and individual technical men can devise some form of table along the same general line as the one presented in incomplete shape in the accompanying illustration, it would prove of great assistance both to sand producer and sand consumer.

Develops High Heat Resisting Alloy

BY G. R. BROPHY

A FRESHLY cut surface of aluminum, like all metals, will show a bright lustrous surface, but after a short time in the atmosphere becomes dull. On longer exposure little change takes place in this strongly adherent coating. This is recognized as a protective coating of oxide. Aluminum when alloyed in solid solution with other metals still retains this property of oxidizing readily and lends this property to the alloy.

Advantage of this property was taken a few years ago when calorizing was developed. This process, which has been described many times, consists of coating metals with aluminum at high temperature, actually forming a surface alloy which is highly resistant to oxidation at high temperature and to many forms of corrosion. Calorizing is not suited for work above 1832 degrees Fahr., due to the rapid diffusion of aluminum and the consequent lowering of the surface aluminum content to the point where breakdown under oxidation is bound to occur.

A homogeneous alloy made by melting aluminum with iron naturally will show no such diffusion on subsequent heating, and provided the aluminum content is sufficiently high, the alloy will resist oxidation at temperatures nearly up to its melting point. Unfortunately, on repeated heating and rapid cooling, or uneven heating, these alloys crack badly and no homeopathic doses of any third metal tried—and nearly all were tried—helped this condition. The hot metal when the least moisture touched it acted like hot glass, flying to pieces.

The low expansion of high nickel steels together with the fact that aluminum and nickel form a high melting compound led to investigating the promising ternary alloys of aluminum, nickel and iron. Therefore, keeping aluminum at a minimum and substituting nickel for iron in various percentages, a series of alloys was obtained which showed increasingly good properties. However, when nickel reached 15 per cent the alloy was soft and lost nearly all its resistance to oxidation. This was probably due to the formation of the high melting compound corresponding to the formula NiAl, which, while highly resistant to oxidation itself, robbed the iron of its protection and allowed the iron to scale badly. Further additions of aluminum and nickel in proportions other than that of the above compound finally gave an alloy which was strong; would stand shock, hot or cold; could be quenched repeatedly; and was highly resistant to oxidation. A few further refinements gave the alloy which was finally adapted and which we call calite.

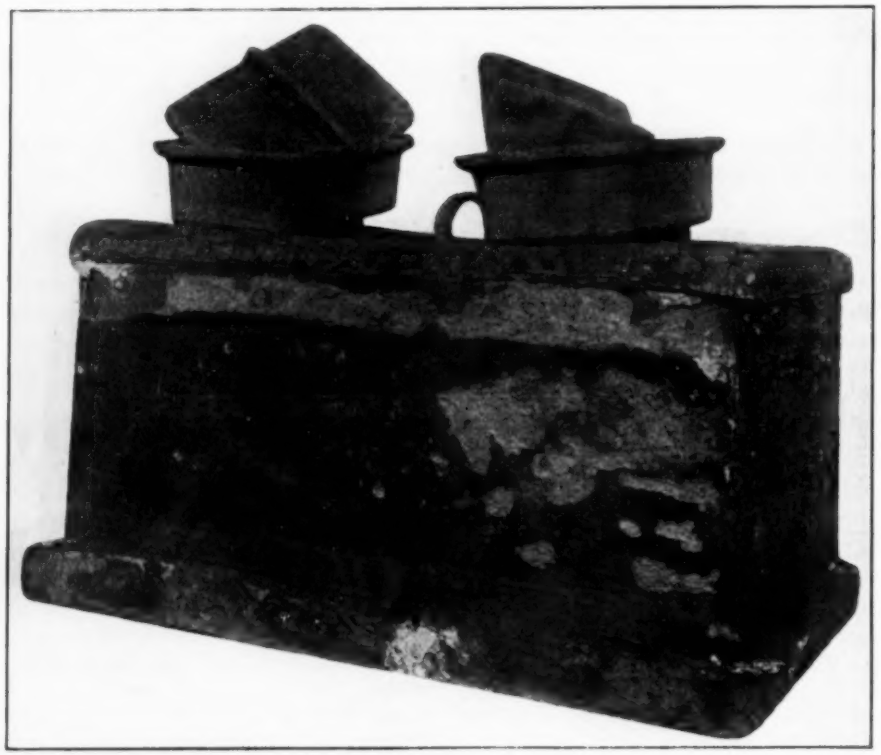
Manganese and silicon above 0.75 per cent both tend to decrease resistance to oxidation, but with care in melting, no trouble is experienced. Carbon increases brittleness and should be kept as low as possible and easily runs under 0.05 per cent. On account of the ease with which SiO_2 slags with aluminum, the melting must be done in a basic furnace. Also the ladle used must have a basic lining.

Basic heroult type furnaces are used with good success. Steel scrap is first melted down and decarburized; slag is removed and nickel is added and a new slag made. When all is thoroughly deoxidized, the final slag is

From a paper presented at the New York sectional meeting of the American Society for Steel Treating, March 3, 1922. The author is metallurgical engineer, industrial furnace department, General Electric Co., Schenectady, N. Y.

removed and scrap calite added to the extent of 25 per cent of the melt and dissolved. The melt is then poured in a preheated ladle containing the required amount of molten aluminum. As this alloying takes place, an exothermic reaction occurs of sufficient intensity to dissolve additional scrap, and up to the present, scrap amounting to 15 per cent of the melt has been dissolved with sufficient residual heat to necessitate holding in the ladle several minutes. The ladle is bottom poured so that the time of holding allows all oxide to float and nothing but clean metal to be poured.

The metal runs freely, and sections of 3/16-inch have been cast successfully. Any casting which can be made of steel can be made of calite. The shrinkage being the same as steel, the same precautions must be taken.



ANNEALING BOXES MADE FROM THE NEW HEAT RESISTING ALLOY, HAVING RUN 1500 HEAT HOURS WITHOUT WARPAGE OR GROWTH

Calite resists oxidation up to 1300 degrees Cent. (2372 degrees Fahr.) but 1200 degrees Cent. (2182 degrees Fahr.) is recommended for indefinite service. The protective oxide formed is tight and does not snap off even on quenching from high temperatures. Quenching after 100 hours at 1200 degrees Cent., calite lost but 0.03 gram per square centimeter exposed, while the best heat resisting base metal alloy other than calite lost 0.56 gram under the same conditions. The same samples were run at 1300 degrees Cent. for an additional 25 hours. Calite lost 0.003 gram, the other 0.09 gram per square centimeter exposed. From these figures it appears that calite is 20 times as resistant at 1200 degrees Cent. and the only base metal alloy to stand at temperatures higher. At 900 degrees Cent. or ordinary operating temperatures the loss per square centimeter was measured in 1/10 milligram, or for all practical purposes no loss.

Calite is practically noncorrosive. Samples have been polished and run in a spray of saturated sea salt solution at 100 degrees Fahr. for 200 hours and at the end of this time still retained the perfect polish. So-called stainless steel will last but a few hours in this test. For fittings exposed to salt atmosphere calite should be excellent.

Twenty-five per cent sulphuric acid dissolves calite rapidly; hydrochloric acid slowly and nitric acid hardly at all. Forty-eight hours in 25 per cent nitric acid, the metal lost 0.0004 gram per square centimeter exposed. Acetic acid has no effect. Molten carbonates, chlorides, nitrates, cynanides, Pb, Zn, Sn, type metal, sulphur and sulphur vapor do not attack calite. CO_2 gas at 900 degrees Cent. has no attack. Fluxes such as cryolite, borates and silicates attack calite rapidly.

In general, the physical properties are as follows:

Melting point, degrees Fahr.	2777
Softening temperature, degrees Fahr.	250[illegible]
Working temperature, degrees Fahr.	2200-2370
Specific gravity	7.0[illegible]
Weight per cubic inch, pounds	0.2[illegible]
Brinell hardness, annealed	286
Sclerescope hardness, annealed	40
Thermal conductivity, per cent of iron	25
Transverse stress, 1 inch square bar, pounds per square inch	4250
Tensile stress, pounds per square inch.	36,800

Calite cannot be machined in the cast condition, nor cut with oxy-acetylene. Any change of dimension or finish must be done by grinding. It is more resistant to oxidation at high temperatures and will stand higher temperatures than any base metal alloy tested. Its first cost is low and operating cost lower than other non-oxidizing alloys. Boxes shown in the accompanying illustration have been run for 1500 heat hours and will be seen to be in the best condition. Measurements of these boxes show no warpage or growth. The oxide coating is no heavier now than after the first heat.

Will Make Awards at the Rochester Exhibition

The board of directors of the American Foundrymen's association recently announced the conditions governing the award provided through a gift of the S. Obermayer Co., Chicago, announced at the Columbus convention in October 1920. The gift of $1000 was provided with the stipulation that the interest should be used at the discretion of the board of directors as an award for some accomplishment by workers in the foundry.

The conditions which govern this year's presentation are announced as follows:

This award which is known as the S. Obermayer Co. award, will be given to the person submitting a drawing or model of some jig or device which, in the opinion of the judges, embodies the best ideas for a device to help in the economical production of castings. The jig or piece of equipment for which this award is given shall not be patentable, but shall be such a device as can be constructed in any foundry and used in the production of castings, in coremaking, molding, pouring or handling operations.

The models or drawings of the devices which are submitted in this contest will be on exhibition in a booth at the Exhibition Buildings during the annual convention of the association at Rochester, N. Y., the week of June 5.

Contestants for this award will be limited to men who are foremen or workers in foundries, or in some department of a plant operated in connection with a foundry, and they should file notice with the secretary of the association of their desire to contest, and receive further information as to conditions. In granting this award the judges will follow the general rules for granting awards laid down by the awards committee.

The iron production in France for 1920 was 13,871,187 tons, and in 1919 it was 9,429,789.

Heater Sections Made in Quantity

Extensive and Elaborate System of Providing Large and Continuous Vents in the Cores Automatically Removes the Most Dangerous Factor in Producing Castings of This Character

THE many and varied reasons responsible, directly and indirectly for the high state of perfection to which the manufacture of various forms of steam and hot water heating units has attained may be reduced to two at the most, and since in the final analysis, these two interlock and hinge one upon the other, perhaps it is safe to say that they may be reduced to one. The first reason and one that embraces most of the others, lies in the fact that the castings are subjected to a severe heat and pressure test during the entire period of their active life and therefore must be uniformly perfect. The second reason is that the entire output for the country is controlled by a comparatively few manufacturing companies and therefore standardized methods have been adopted earlier and to a greater extent than if the business was scattered among a multitude of small manufacturers.

Cast iron boilers designed for low-pressure steam or hot water are divided into two general classes, but both classes are alike in that they are made up of a number of individual sections. In the first class a number of hollow circular disks filled with water are arranged over each other horizontally in such a manner that the heat from a fire underneath passes through suitable openings on its way to the stack, thus heating the water in the disks and causing it to circulate. In the second class, typical examples of which are described and illustrated in the following pages, the sections are rectangular in shape and are erected vertically side by side when assembled in varying numbers to constitute a complete heating unit. In addition to the three openings, one at the top and two at the bottom, through which the water circulates, each section, with the exception of the front and the back is provided with suitable openings through which the heat from the fire may circulate before escaping into the chimney.

A hot water or low-pressure steam heating system arranged on the gravity principle comprises distributing mains connecting with the top of the boiler and with vertical riser pipes from which horizontal branches lead to the radiators. Uusually a return pipe is connected to the opposite end of the radiator from that at which steam or water is admitted, this return connecting through return risers and mains with the boiler. On steam boilers this connection is made at a point below the water line. On a hot-water installation the entire system is filled with water. As the water becomes heated in the boiler it becomes lighter in weight per cubic foot, making a difference in pressure between the flow and return pipes and thereby causing a circulation. The water rises in the flow pipes to the radiators and loses some of its heat. On its return to the boiler it again is heated and the circulation will continue as long as a fire is maintained in the boiler.

The heated gases pass from the fire bed up into the combustion flues, back to the rear of the boiler and up into the side flues, then forward through side flues to the front, thence into the center flue and out through the smoke hood at the rear. The distance which the gases are forced to travel permit the surfaces on which they impinge to absorb the maximum amount of heat and therefore the gases are discharged into the smoke hood at a relatively low temperature.

It is apparent from the foregoing that the castings are subjected to a peculiarly severe service test and their successful production in commercial quantities and on a competitive basis is a tribute to the foundry skill and knowledge of those who designed the rigging, and to the skilled supervision exercised by the men directly in charge of the casting plants. The routine work or series of motions involved in the actual making of the molds is performed by workmen in the class usually designated as semi-

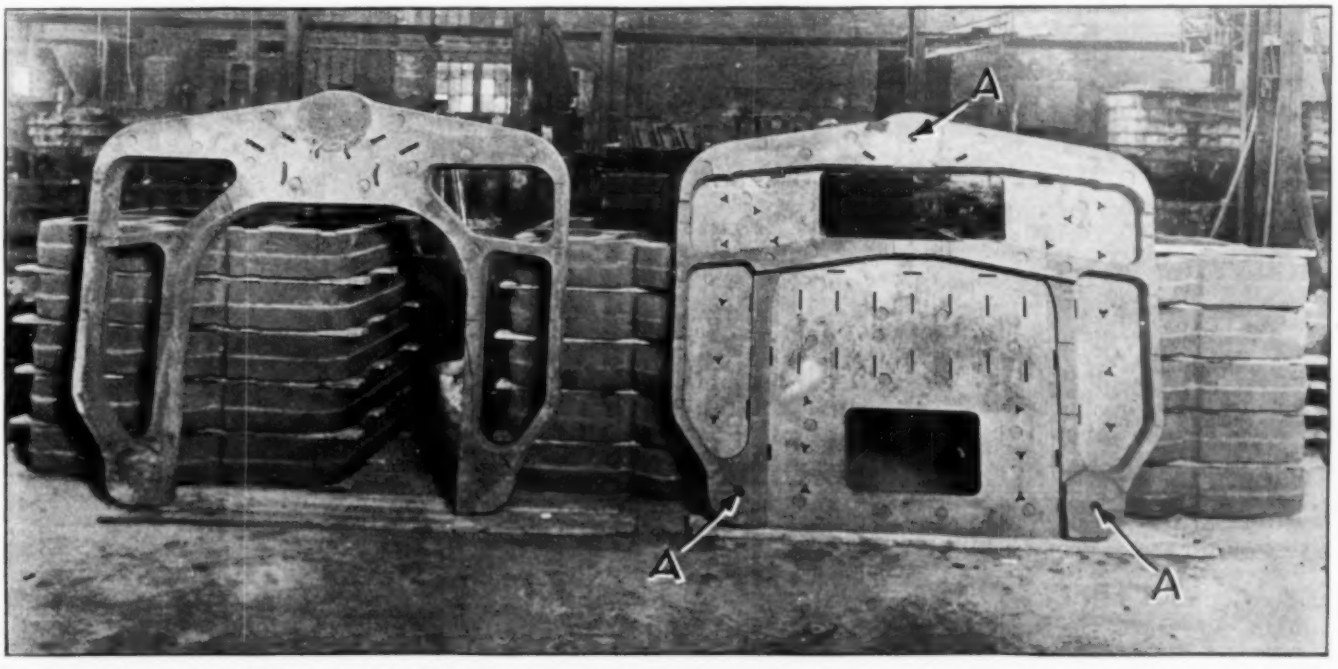


FIG. 1—THE ENTIRE CORE IS SURROUNDED WITH IRON WITH THE EXCEPTION OF THREE SMALL OPENINGS. ALL THE VENT MUST PASS THROUGH THE THREE SMALL HOLES INDICATED AT *A A A*

and Edwardsville, Ill. The West Newton plant also produces wall radiation and radiator specialties.

The Detroit plant comprises besides the foundry and all the appurtenances pertaining thereto, a second building in which the castings are tested, machined, assembled and shipped. A power house also is maintained on the premises which furnishes all the direct electric current required and also the compressed air for operating the molding ma-

FIG. 2—THE STREAM IS STOPPED DURING THE PROGRESS OF THE HEAT A SELF SKIMMING SPOUT TAKES CARE OF THE SLAG

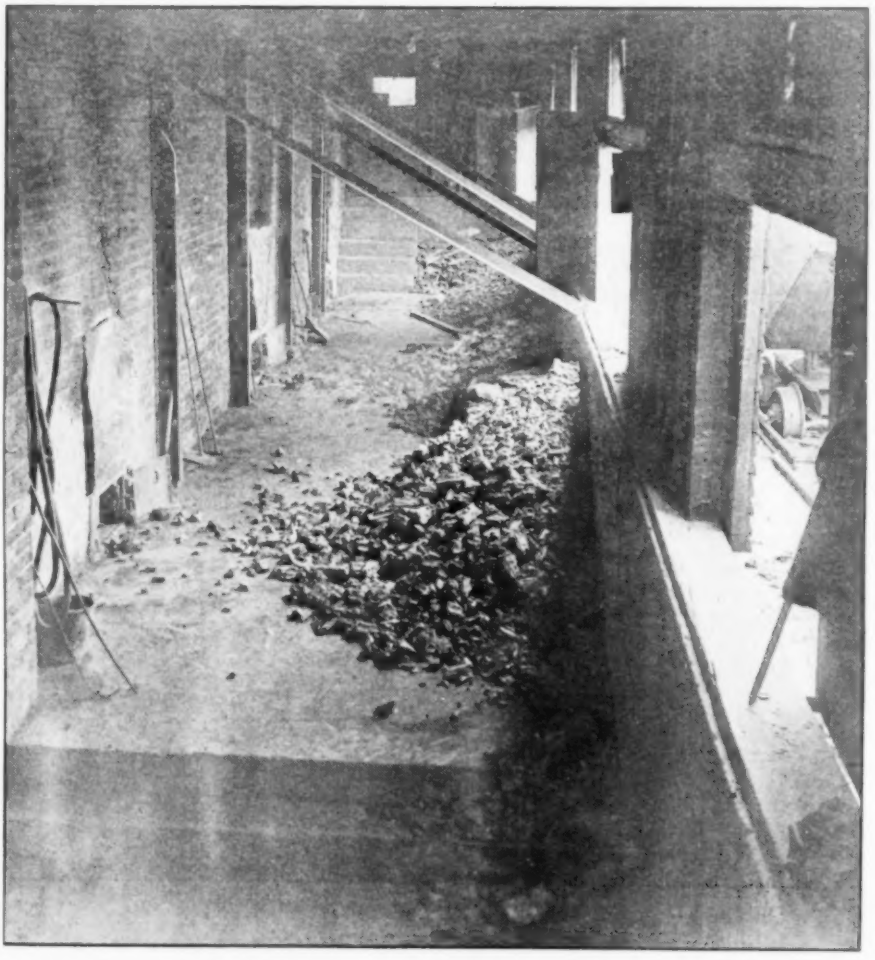
chines and other pneumatic pieces of equipment. Alternating current is supplied from outside source for the lights and also for operating the sandcutting machine.

The foundry building of brick and steel frame construction is 120 x 260 feet. It is divided by two rows of columns spaced on 20-foot centers into three longitudinal bays of approximately equal width extending the full length of the building. A monitor extends

skilled. For instance, on the boiler section the men are divided into gangs in which each man has definite designated duties to perform and he does just that, no more and no less, day in and day out. The result is that while he may be classed as semiskilled in the sense that he is not an all-around molder, he is a highly skilled specialist in his own particular groove.

Specialization and concentration of effort is characteristic of the heating industry and where the conditions are

FIG. 3—THE BATTERY OF COKE OVENS IS FIRED FROM A COMMON FIRING CHAMBER AT THE BACK



similar, is carried to a logical conclusion as in the case of the United States Radiator Corp. This company with executive offices in Detroit controls and operates foundries devoted to the manufacture of various types of heating units in six different cities including Detroit. The Detroit plant makes nothing but square boilers, while round boilers are made exclusively in the plant at Geneva, N. Y. A standard column of uniform type of radiator is made at each of the plants controlled by the corporation in Corry, Pa., West Newton, Pa., Dunkirk, N. Y.,

from end to end over each bay and aids in ventilating and lighting the building.

The cupola, built by Bryam & Co., now known as the Northern Engineering Works, Detroit, stands close outside an archway built in the brick wall of one of the side bays. The spout projects far enough on the inside to fill a stationary ladle, which in turn delivers iron to ladles suspended from the crane, or mounted on a truck employed to carry them to the second and third bays. A brick wall built as high as the bottom is not slagged during the process of melting a 40-ton heat. It is slagged, and slagged quite freely, but the slag flows over the side of the spout in front of the cupola. The peculiar shape of the spout will be noted by referring to the illustration Fig. 2. It also will be noted that the spout is provided with a hinged joint at one side and a catch in front the former to save the cupola tender the trouble of lifting the heavy spout off and on for repairs and the latter, of course, to lock it in place while in use. In practice the spout ment on a few cupola peculiarities. The side bay located adjacent to the cupola room is served by a 3-ton crane made by the Shepard Crane Co., Montour Falls, N. Y. One end of the bay is used as a molding floor. Molds for boiler sections are made on a plain jolting machine made by the Herman Pneumatic Machine Co., Pittsburgh. This machine differs from the remaining machines in the shop in that it is equipped with neither stripping plate or rollover mechanism. The molds are lifted directly off the pattern and for that

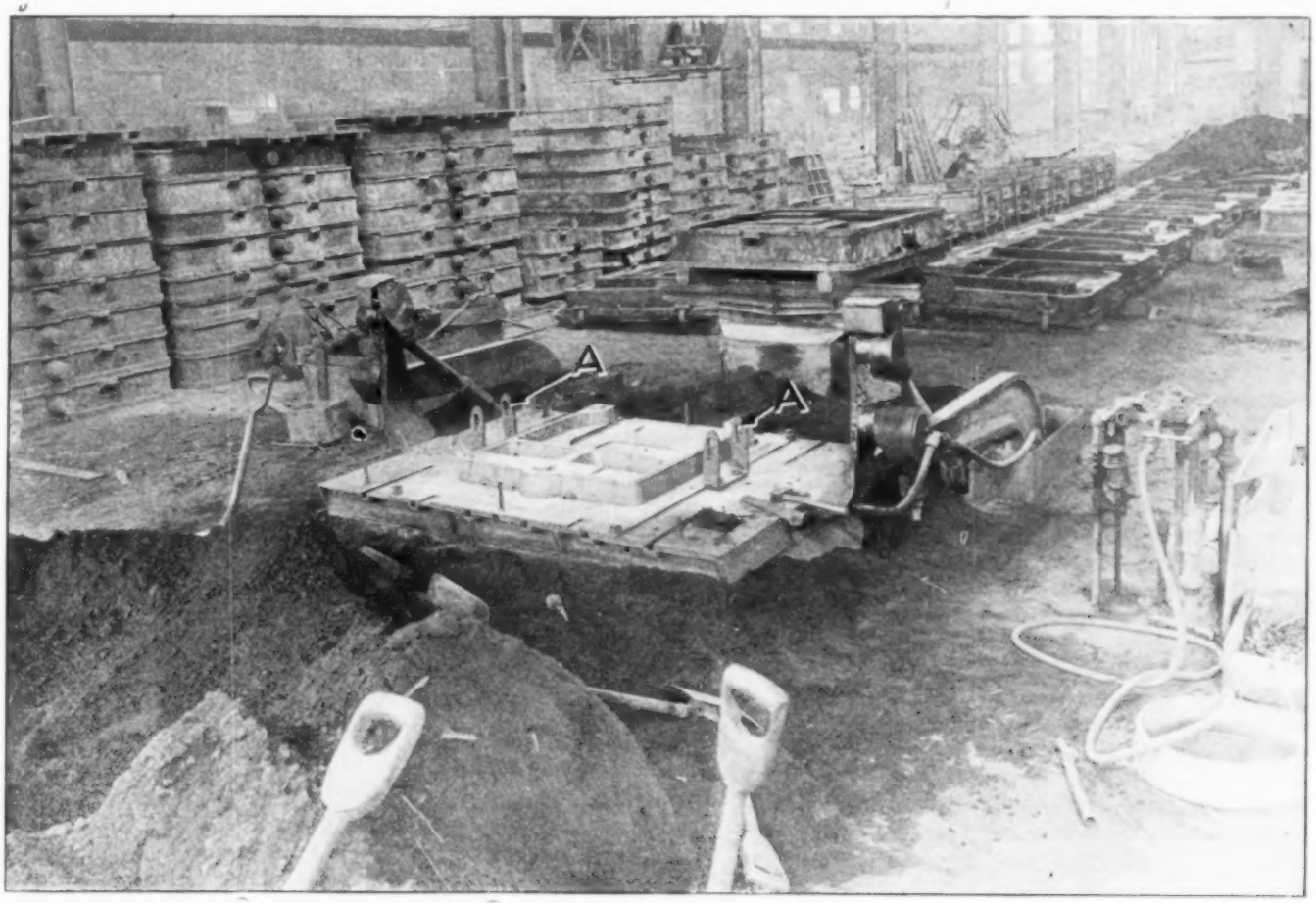


FIG. 4—GENERAL VIEW OF ONE SIDE OF THE CENTRAL BAY. THE MOLDING MACHINE IN THE CENTER IS ONE OF THREE ON WHICH ALL THE SECTIONS ARE MADE

plate between the two front legs protects the front of the cupola when the bottom is dropped.

A peculiarity of this cupola is that the stream is never stopped from the beginning to the end of the heat, and on the average day's heat of 40 tons, no slag is drawn off at the back. A slag hole is provided at the back, but the only purpose it serves is to permit the introduction of an oil torch used in connection with the wood kindling for igniting the coke bed. After the fire is well under way the hole at the back of the cupola is closed with a brick and daubed with mud.

It must not be inferred from the foregoing that the cupola, lined to 60 inches, serves as a reservoir and skimming device. The iron before it reaches the outer end of the spout has to pass under a diaphragm, or bridge wall. The body of iron between the bridge wall and the tapping hole remains at a constant height and since the slag has a lighter specific gravity than the iron, it flows off through a channel in the side of the spout located a trifle above the level of the iron.

Ample Crane Service

Before touching on the molding and melting methods employed in this foundry it is perhaps as well at this point to take up the general layout, interrupted a few paragraphs back to com-

reason it is necessary to provide the drag part of the flask with a full set of bars similar to those in the cope.

The space in front of the cupola is devoted principally to repairing and drying the ladles and the remaining floor space in this bay is used as a general storage for cores, flasks, bottom boards and core plates. The cores shown in Fig. 1 are in this bay. The upper end of the bay opens directly all along one side into the core room, a description of which will be taken up more in detail later. In addition to the 3-ton crane already referred to, a narrow-gage track extending along the floor close to the inner row of columns affords a ready means of transporting materials, includ-

FIG. 5—THE MOLDS ARE ARRANGED IN A ROW CLOSE TO THE COLUMNS SO THAT THEY MAY BE POURED FROM A LADLE SUSPENDED FROM THE MONORAIL

ing cores, from one place to another.

The center bay partly shown in Figs. 4 and 5 is used altogether as a molding floor with the exception of a small space across one end where the core sand is knocked out of the castings. Three molding machines similar to that shown in Fig. 4 made by the Herman Pneumatic Machine Co., Pittsburgh, and spaced approximately equal distances apart along the center line of the floor, serve to make all the boiler sections. The bay is spanned by three cranes. A 2 and a 3-ton made by the Northern Engineering Works, Detroit, and one 3-ton crane made by the Shepard Crane Co., Montour Falls, N. Y. The bay is divided practically into three self contained units with a molding machine and a crane to serve each one.

All the boiler accessory castings are made in the third bay. They include front, back and side foundation plates, grates, doors, dampers, nipples, besides many other little odds and ends. This bay is exceptionally well lighted through sky lights and is equipped with a number of molding machines supplied by various firms including the Osborn Mfg. Co., Cleveland; the Tabor Mfg. Co., Philadelphia; Henry E. Pridmore, Chicago; and Hanna Engineering Works, Chicago.

Auxiliary Castings

The castings with the exception of the nipples are assembled without machining and, therefore, it is essential that they be uniform and accurate in size, weight and overall dimensions, and free from warps, twists or cracks. Care and skill observed in preparing the molds, and a supply of iron at the proper temperature with which to pour them, usually constitutes the necessary procedure, but in some instances, particularly the long side foundation plates it is necessary to shake out the casting immediately after it is poured, knock off the sand and prop the casting up on edge so that it may cool equally on both sides and thus prevent distortion.

The castings are sandblasted, chipped and water tested in a long narrow room adjoining the third bay, just described, and from there are wheeled into another adjoining room where they are stored or machined and assembled, crated and shipped. The assembly room is provided with a number of machine tools for facing and drilling the water connections in each section.

Flask Construction

The style of flask employed for making the sections is illustrated in the cope shown in Fig. 7. In addition to the projecting sand strip on the inside of the joint edge, it may be noted that the bars which occupy the pocket spaces in the pattern also are provided with sand strips. With this construction, gaggering is reduced to a minimum. Owing to the general drab appearance of the cope newly clay-washed, the blocks for holding the chaplets do not show distinctly in the illustration. These blocks are not cast integral with the cope but are bolted to the bars at the required points. An oval hole in each block permits of a considerable range of adjustments to fit different patterns.

Chaplet Supports

The joints of all the flasks are machined to a true plane either on a planer or a surface grinder. Lugs at each end drilled accurately to a jig are used for locating the flasks on the molding machine and later in the day in locating the copes on the drags. By referring to Figs. 4 and 5 it may be noted that on some of the flasks the guide lugs are on the same side as the trunnions, while on others the lugs are on the ends and the trunnions are on the sides. The only difference it makes is that a beam and pair of straight slings like those shown in Fig. 7 may be employed when the lugs are not on the same sides as the trunnions. Where the trunnions and lugs are on the same sides it is necessary to use slings provided with an offset as shown at *B* Fig. 5.

Instead of having the usual rectangular corners these flasks are nicely rounded. This feature in addition to conforming closely to the shape of the pattern and thus conserving on the supply of sand necessary to fill the flask, also is in accordance with accepted foundry practice in avoiding as far as possible, sharp corners in construction subject to alternate heating and cooling. The copes are provided with exterior flanges, top and bottom, close to the

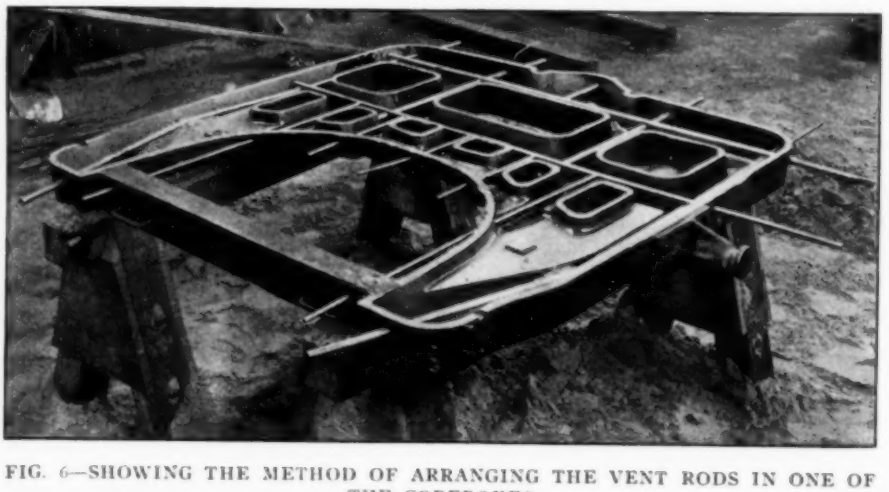


FIG. 6—SHOWING THE METHOD OF ARRANGING THE VENT RODS IN ONE OF THE COREBOXES

edges. The drags carry a reinforcing flange around the bottom, but none around the top or joint edge.

The drags are provided with several rigid bars cast integral with the frame. These bars serve the double purpose of affording added strength and rigidity to the drag and also as anchor piers for supporting the chaplets. Cast iron strips 4 inches long, 2 inches wide and ½-inch thick, terminating in round plugs 1 inch in diameter, are bolted to the bars at certain definite points in relation to the core. The method of clamping the bottom board to the drag by short steel hooks permanently hinged to the lower edge of the drag frame, is shown in Fig. 5.

Five different size boilers, but all of the same general design, are made at the Detroit plant. Each boiler requires one front, one back, and a varying number

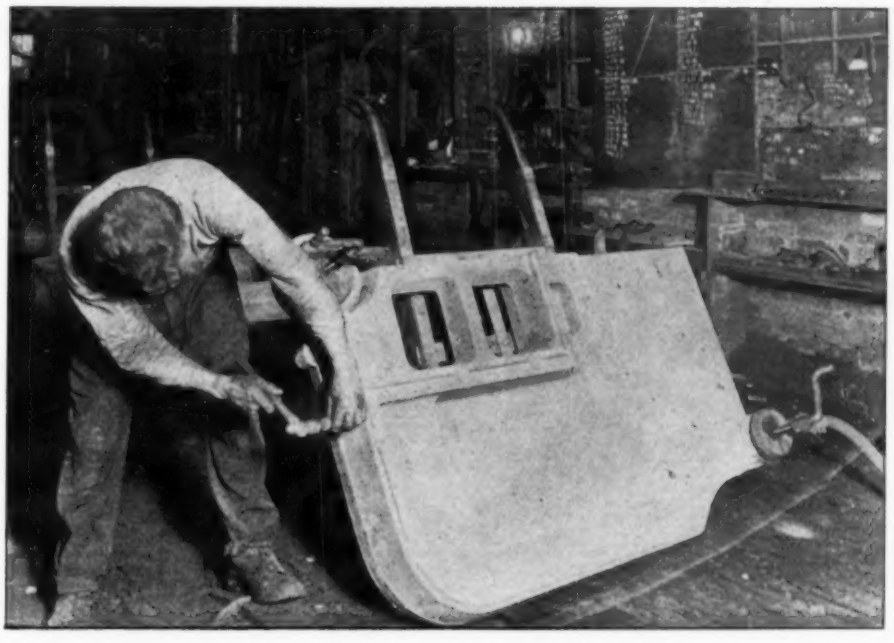


FIG. 8—CASTINGS ARE WATER TESTED

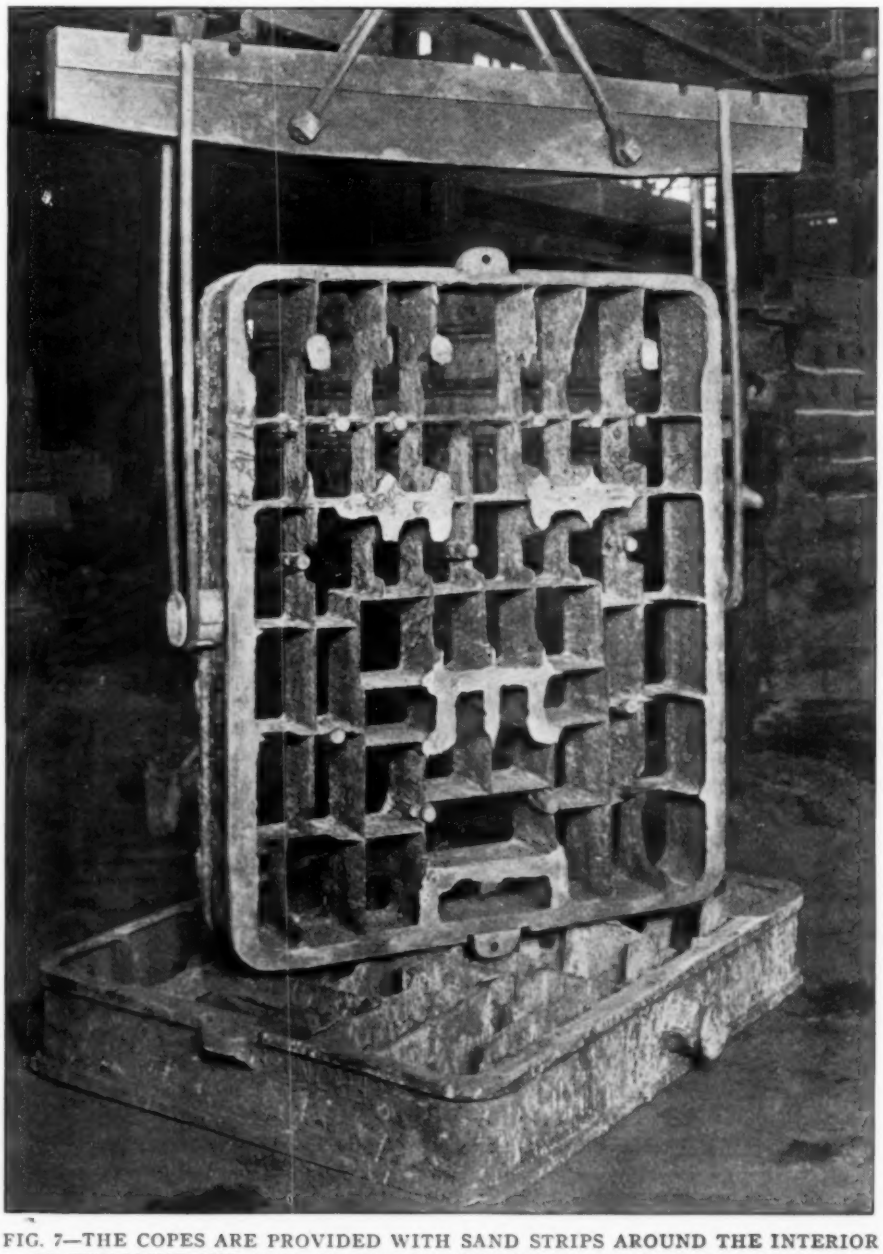


FIG. 7—THE COPES ARE PROVIDED WITH SAND STRIPS AROUND THE INTERIOR OF THE JOINT AND ALSO ON THE BOTTOM EDGES OF SOME OF THE BARS

of intermediate water sections. The installations vary according to local conditions and customer's specifications. The design is elastic and a boiler may be expanded or contracted to meet changes in operating conditions by taking away or adding one or more intermediate sections.

Cast iron patterns split horizontally through the center and each half mounted on an individual accurately machined plate, are provided for each section of each size. The plates are provided with bolt holes for securing them to the table of the molding machine. So far as possible, the machine is employed all day on one size, but occasionally it is necessary to make a few molds from various patterns and for that reason it has been found more advantageous to attach each half pattern to its own individual match plate rather than try to adapt many patterns to one plate. To change patterns it only is necessary to slack off four bolts, lift away the plate and attached pattern, set on a second plate and pattern, and tighten the nuts on the four bolts again.

All Piece Work

The castings are made on a piece work basis by a gang of six men on each machine. Four men attend to filling the flask with sand, placing bottom board, clamps and rolling over; the remaining two men finish the molds, set the core, close and clamp them. The drag and cope are made on the same machine. Where the casting is symmetrical the one half pattern serves for making both the cope and drag. In other cases the floor of drags is put up first, then the pattern is changed and the requisite number of copes made to cover them. The

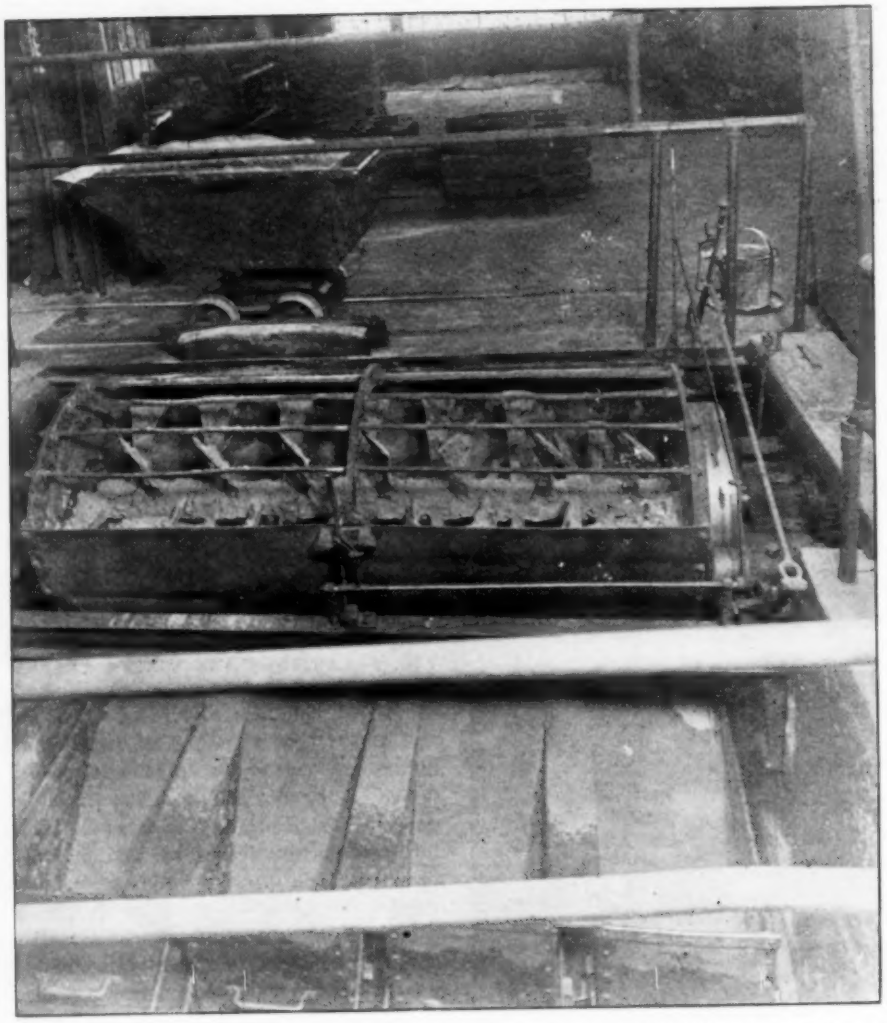


FIG. 9—CORE SAND IS MIXED IN A PADDLE TYPE MACHINE WITH A CAPACITY OF 112 GALLONS TO A BATCH

two yokes shown at *AA*, Fig. 4 present a ready means of fastening the flask to the pattern plate and prevent it from moving during the operation of ramming the sand. The flask is lowered into place guided by suitable pins. The yokes are designed to embrace the trunnions at each end of the flask. After the flask is in place a wedge key similar to the one shown beside the hammer on the right hand end of the machine table, is inserted through the slots in the yoke and driven in tightly over the trunnion. After the flask is rammed and turned over on the cradle the keys are knocked out and the flask is lowered away from the pattern.

With these machines both cope and drag are rolled over as they leave the machine. The drag is left in that position and placed upon the floor, but the cope is picked up by the trunnions and inverted again before it is placed on the drag. Rolling the cope over on its back in the first instance facilitates making any minor repairs and also furnishes an opportunity for attaching the cores that make the nipple openings in the casting. All the vent from the large flat cores is taken off through three, and in some cases, two, small holes in the cope. It is essential that the core prints carrying the vents should fit tightly into the core prints in the cope face of the mold. To insure this condition the short round pieces of core designed to form the holes are made separate from the remainder of the core and placed in the prints before the mold is closed. Gravity holds them in their places in the drag but in the cope it is necessary to apply paste and a few wires with flat toes, and then pinch and slick the green sand around them.

The number of molds made by each gang varies occasionally, depending on circumstances, such as the size of the pattern and the number of changes that may be necessary. Usually it runs from 30 to 35. On occasion by adding one or two extra men to the gang the output has been raised to 40 molds for the day. However, it has been found that six is the most economical number of men to work in a gang and under ordinary routine conditions the gang is held to that number.

The molds are laid down and assembled for pouring in two long rows one on each side of the center bay only a few feet from the columns. This arrangement serves a double purpose. In the first place, it reserves a wide and roomy space in the center for shaking out the flasks and tempering the sand. In the second place, the row of molds on the righthand side of the illustration, Fig. 5, may be poured from a ladle suspended by a trolley from a monorail attached to the columns below the crane runway and extending from one end of the bay to the other. In this manner the cranes may be kept in service over the molding machines practically all the time and permit molding operations to be carried on during the pouring of the heat.

The battens on the bottom boards are several inches higher at one end than at the other. This may be noted in Fig. 5 which shows that the boards are attached to the drags in such a manner that the runner is on the high end of the mold. Neither skim gates or pouring basins are employed. The metal is poured directly into the flared opening of the single upright runner. At the joint the gate is divided into a number of thin flat branches connecting with the mold. A small pop riser is taken off two points on the top of the casting at the low end of the mold. Whenever the metal appears in the risers, pouring ceases at the runner end. A ¼ x 3-inch steel strip is used to reinforce the bottom board at each end where it is gripped by the clamps.

Mixing the Sand

A night gang shakes out the molds, takes the castings to one end of the shop and stacks the flasks for the following day's operation. The sand is wet down and cut over in long windrows by a sandcutting machine made by the American Foundry Equipment Co., New York. A grab bucket suspended from the crane is employed to pick up the sand from the windrows and deposit it in a pile close to each molding machine. During the day the bucket is employed to fill the flasks with sand. A little facing sand in which coal dust has been mixed in the proportion of 1 part of coal dust to 8 parts of molding sand, is used to cover the pattern at the gate end, but sand direct from the heap is employed to cover the remainder of the pattern and to fill the flask.

Several stacks of the water chamber cores used in the boiler sections are shown in Fig. 1. The two cores shown standing on edge are typical of the general characteristics of cores used on this class of work. It readily will be apparent that their successful production presents many problems. It is essential that they

be strong and rigid to withstand the handling required in pasting the halves together, in placing them in the molds and in resisting the pressure of the molten iron while the molds are filling. The core shown to the right, Fig. 1, furnishes an extreme example of the latter kind. The many small openings through the web are designed to reduce the pressure and also to prevent the casting from showing cold shut streaks over the wide expanse of surface.

Making the Cores

The only outlets for all the gas and smoke generated during the pouring of the casting are the three small vents indicated at *AAA*, Fig. 1. The remainder of the core is completely surrounded with iron and since the iron at no place is over ⅜-inch thick it follows that the least blow from the core would be fatal. The use of rods or arbors to reinforce the core is limited by the fact that everything inside the casting must be removed through the three small openings shown at *BBB*, Fig. 12. Owing to the same limiting factor the amount of binder in the core sand must be so nicely proportioned that it all will burn out from the heat of the casting and leave the sand free to disintegrate and run out of the casting in the cleaning room. At the same time it must be sufficient in quantity to make a strong rigid core capable of withstanding severe service.

The core room 40 x 140 feet lies parallel to and adjoins the same side bay as the cupola. It is not separated from the foundry proper by a partition of any character, simply forming an additional side bay. Extensive skylights in the roof furnish ample light for the core makers. Two traveling cranes span the core room. One of 1-ton capacity and the other of 2-ton capacity made by the Northern Engineering Works, Detroit.

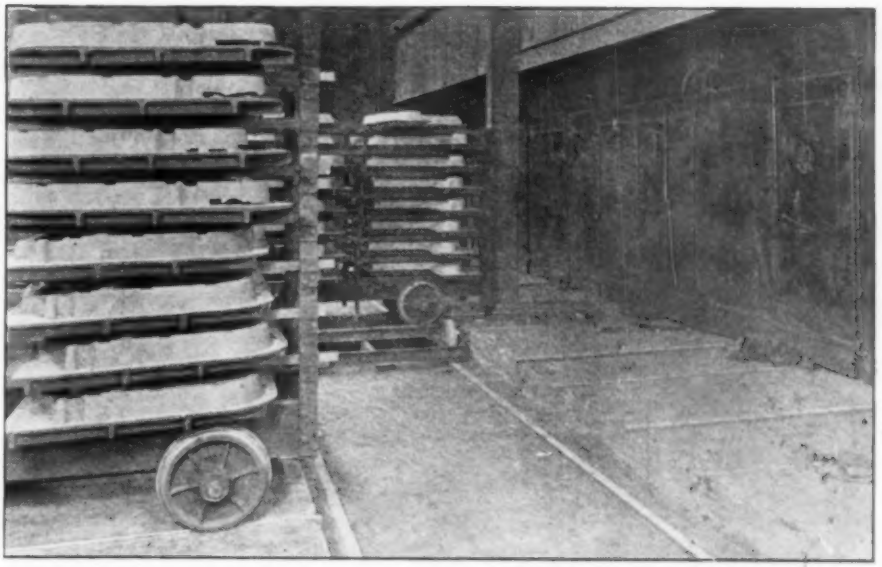


FIG. 11—WITH A DEPRESSED TRACK AND TRANSFER CAR THE CARS OF CORES READILY MAY BE SWITCHED TO ANY DESIRED OVEN

The cores are made from all sharp sand bonded with an oil binder supplied by Werner G. Smith Co., Cleveland. The sand is mixed in a paddle-type dumping drum made by the corporation to its own specifications. Each batch comprises 112 gallons of sand and 1¾ gallons of binder, a ratio of 1 to 64. The man mixing the sand adds a sufficient quantity of water to temper the sand to the proper working condition. The amount will vary from time to time depending on the condition of the sand as it is brought into the shop.

The mixer shown in Fig. 9 is located in a concrete pit in the floor near one end of the core room. Four steel pans shown on the bottom of the pit receive the sand after it has been mixed. The small swivel truck shown at the top of the illustration is used for bringing the sand in from the storage pile and the can shown to the right is employed for measuring the oil binder. The lever shown at the back of the pit on the right is employed to manipulate a friction pulley which turns the mixing pan upside down and dumps the mixed sand into the four boxes underneath. The second lever controls the latch which holds the pan in an upright position. Each batch of sand remains in the pan for approximately 10 minutes and one man is able to handle 22 batches a day.

Extensive Vents

In addition to the natural porosity of the sand, vent channels are provided in the body of the core in the manner illustrated in Fig. 6 which shows one of the coreboxes with a set of vent rods in place. Some of these rods extend through opposite sides of the corebox. Others project through only one side, the inner ends terminate in small pins which fit in corresponding holes in the sides of the long rods extending from side to side. The bend on the two outside end rods is achieved by providing two rods with pin and socket joints at these points.

The usual procedure in making one of these cores is to shovel a thin coating of sand all over the bottom of the corebox. A rod bent to the shape of the inside of the box then is laid on the sand and several other rods are laid at strategic points between the natural divisions to reinforce and strengthen the core. The vent rods then are placed in their proper positions after which the box is filled with core sand and rammed by the coremakers, two men on a floor. A long steel straightedge is employed to scrape the surplus sand from the top of the core-

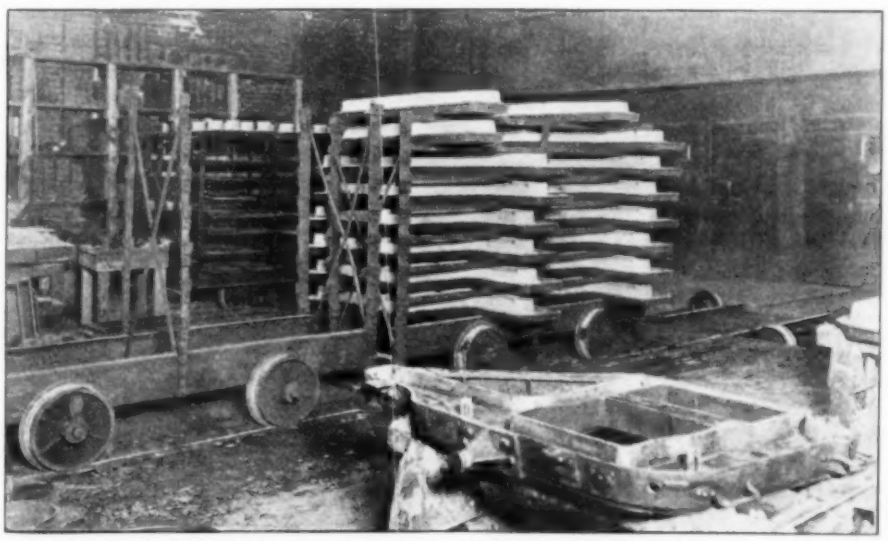


FIG. 10—THE SIDE BARS ON THE CORE CARS ARE DETACHABLE AND ARE ADDED ACCORDING AS THE CAR IS LOADED

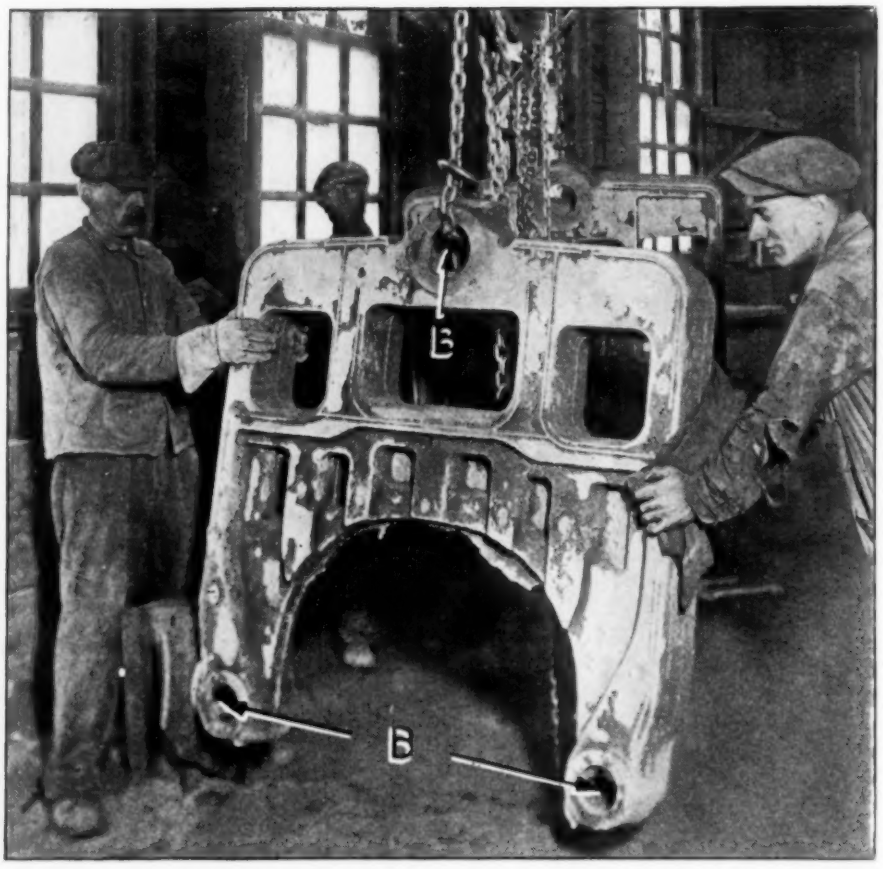


FIG. 12—THE CORE SAND IS KNOCKED OUT OF THE CASTINGS BY BUMPING THEM AGAINST THE END OF A RUBBER COVERED RAIL ANCHORED IN THE FLOOR

box and then the core plate is set on by the crane and clamped with a pair of special, quick-acting screw clamps, several of which may be seen on a rack shown at the back of Fig. 6.

After the plate is clamped the vent rods are pulled and then a beam and pair of short slings attached to the crane are employed to roll the core over. The core plates and coreboxes are provided with similar trunnions and therefore the one pair of slings serves to handle either one or the other. After the clamps are loosed and the corebox taken off, turned over and set back on the horses, the core is picked up by the crane and placed on one of the core cars. The construction of these cars is indicated in Figs. 10 and 11. Two channel beams support a pair of uprights at each end and a pair in the center. Seven short offsets are bolted to the outside of each upright at equal distances apart and furnish a resting place for the flat bars used to support the core plates. These bars are detachable. In loading the car the first cores are laid directly on the frame, then a long side bar is dropped into place on each side upon which the two following cores are laid, and so on up to the top. In unloading the cars the process is reversed. An extremely simple and convenient arrangement.

The core room is served by one 2-ton and one 1-ton crane made by the Northern Engineering Works, Detroit. After the cars are loaded they are pushed on to a transfer car operating on a depressed track in front of the battery of ovens shown in the illustration Fig. 11. The battery comprises three double ovens with accommodations for four cars in each, and two single ovens in each of which two cars may be dried at one time. The temperature of the ovens is maintained at approximately 500 degress Fahr. at which the cores dry in about 6 hours. The ovens made by the Detroit Heating Co., Detroit, are coke fired from the back, the heat entering each oven through suitable openings in the floor. The firing chamber is shown in Fig. 3. It is located below the yard level and is supplied with coke by a dumping pan running on a narrow-gage track close to a row of window openings shown to the right of the illustration.

Pasting the Cores

Two day's supply of cores usually is kept ahead of the molders requirements. In this manner the cores have time to cool off after they are taken from the ovens, and men can paste the halves together under favorable circumstances. Many of the halves are duplicates, as illustrated in the core to the left in Fig. 1, while in others the halves present a radically different appearance, as shown by the core to the right of the same illustration. The drag face is shown in the core to the left. It will be noted that no vent holes are visible, while in the cope face shown in the righthand core, the three holes for the vents are indicated at *AAA*. The halves are fitted together and tried with a gage, they then are taken apart and after a thin stream of liquid paste has been deposited on the joint close to the edge all around the outside and also around each of the inner divisions, the upper half of the core is set back in place. The material for the paste is supplied by the E. J. Woodison Co., Detroit. It dries sufficiently hard to hold the core without placing it back in the oven. Four pairs of men make all the cores and another pair paste and assemble them. Another man working in the left-hand corner, Fig. 10, makes all the small cores including between 700 and 800 nipple cores for the sections. As stated elsewhere, the nipple cores are placed in the drag and cope of the mold before the large core is set.

Melting the Iron

Blast for the cupola is supplied by a fan made by the American Blower Co., Detroit. It is driven by a 55-horsepower motor made by the Allis-Chalmers Co., Milwaukee. The charges are made up of approximately 60 per cent pig iron and 40 per cent scrap. The relative proportion of the component parts of the charge vary from time to time depending on circumstances, but they always are made up to yield an anticipated analysis of silicon, 1.80 per cent; sulphur, 0.10 per cent (maximum); phosphorus, 0.60 per cent; manganese, 0.60 per cent. Each charge is made up on an individual truck and weighed on a track scale on its way to the elevator. The iron charges weigh 2500 pounds each, and 225 pounds of coke are used between them. The yard is connected by a spur with the main line of the Wabash railroad.

The core sand is knocked out of the castings in the manner illustrated in Fig. 12. A piece of rail about 6 feet long is anchored in a concrete foundation below the floor with about 18 inches of the upper end projecting above the floor. A section of an old tire is attached to the rail to serve as a shock absorber and then the casting, suspended from a chain block is swung back and forth until all the sand has run out.

Parker Street Castings Co. which has been known as the Imperial Castings Co., Cleveland, recently has been incorporated. H. R. Street is general manager.

Pattern Design Presents Problems—I

Co-operation Between Heads of a Manufacturing Enterprise Will Prevent Many Annoying and Costly Mistakes—Evading Responsibility Will Not Make Up Lost Time

BY JOSEPH HORNER

TROUBLE frequently arises between foremen of departments. The patternmaker may not breathe freely until his work has run the gauntlet of molding, and machine shops. The molder is between two fires of criticism—that of the patternmaker who may be lacking in a proper understanding of, or due consideration for, the economies of the foundry; and that of the machinist who is apt to indulge in cursory language when hidden faults only are revealed after considerable time has been occupied in tooling, or when allowances are scant, or excessive, or metal hard and full of pin holes. The patternmaker often primarily is responsible for what happens to be wrong in both shops, but sometimes he is just a scape goat to bear the sins of others. Obviously in many cases the blame for wasters lies with the molder alone. The employer, if an office man with a minimum of practical knowledge, experiences difficulty in arriving at a decision when listening to the cross fires of conflicting arguments urged by the men who are being hauled over the coals.

Responsibility of two kinds weighs on the patternmaker. One is to decide the best way to mold and pour an object to secure a sound casting. The other is how to economize the work in all the shops. In many cases, no difficulty arises in the determination of the better or the best methods; but the numerous exceptions cause the trouble, sometimes only in one shop but often all around. The craft appears to be almost unique in this respect, for there are so many matters that call for settlement concerning the methods of pattern construction.

Suitable Methods

The various details of molding and of casting different designs, and the question of getting sound castings, cause an experienced man to hesitate in coming to a decision. In some degree, responsibility is divided, because after a pattern goes into the foundry, anticipated results may be prevented by causes beyond the control of the designer and patternmaker. Except in the cases which admit of no choice, the most suitable method of molding is the first question to decide. As a general rule faces which have to be tooled are cast in the bottom of the mold; but often top and bottom faces have to be machined; or all of the surfaces. In some cases a few specks due to honeycombing may condemn a casting. Then, if it is customary to use a special color on all portions of a pattern where tooling has to be done, the responsibility lies with the molder. If this simple indication is omitted the molder is not to be blamed for pouring without special precautions. If he knows that a top surface has to be machined, he will take care to provide ample venting there, or use risers, or pour through a skimming gate, or employ head metal; the choice depending on the character of the work. The metal will be properly melted and well skimmed, and poured into a basin, instead of directly through the ingate.

Casting Face Down

Even when the question of having clean faces is not prominent as in large numbers of instances where the faces are only required for the attachment of parts, certain considerations instinctively indicate the bottom face for molding, although additional work may be thrown on the workman. No one would think seriously of making any of the common forms of beds, Figs. 1 and 2, nor the design in Fig. 3, with the solid faces uppermost in the mold. In each case cores resting on chaplets below have to be fastened in the cope, while if made as they stand in the views, the cores might rest in print impressions in the bottom, a feature generally desirable. On the other hand, it is better for the sake of sound metal and true faces to have the plate portions in the bottom, a rule admitting of few exceptions. These exceptions are designs in which plane areas are present more or less in both top and bottom. In Fig. 3 only four cores can lie in print impressions in the bottom, that for the central crank space, the two for the seatings for the shaft bearings, and one to the right under a facing. The others, fourteen in all, must rest on chaplets, and be hooked into the cope. The cored-up mold is seen in plan in Fig. 4, uncovered, nearly all cores.

Want Small Allowance

Allowance for tooling constitutes a frequent cause of complaint. Machinists do not like excessive amounts entailing an extra cut. Skimping of metal is worse where the *black* will not come out entirely and the hard skin damages tools. Blame for these variations lies with patternmaker and molder, not always because suitable allowances have not been provided, but often on account of effects of shrinkage, the influence of hard cores, and of molds in dried sand and loam. The proportioning of parts in some designs influences results. The more complicated a casting, the greater the number of cores, and the larger its dimensions, the more frequent will be the discrepancies from pattern dimensions. The usual shrinkage allowance on iron of ⅛-inch in 15 inches is far from being uniform. It is only a general average in metal parts quite free to shrink. In other conditions the shrinkage may be hardly half the normal, while cases occur in which it is scarcely measureable, due to the presence of hard cores, in loam and in deep molds where the pressure on large areas is excessive. Castings under these conditions are subject to distortion, and portions will come out approximately the same dimensions as the pattern. Only by profiting from the lessons of experience can these variations be minimized. These facts explain why in the larger, more intricate castings, careful marking-off becomes necessary, that all parts shall *hold-up* for tooling.

Figs. 5, 8 and 9 represent a casting that was troublesome from these causes, due chiefly to the presence of numerous hard cores. The passage cores, over 2 feet long, caused the spaces to be so wide about the central portion that they barely could be tooled. The bore was larger at one end than the other. Flange thicknesses were unequal, due to var-

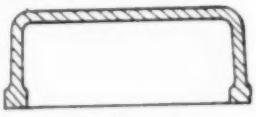
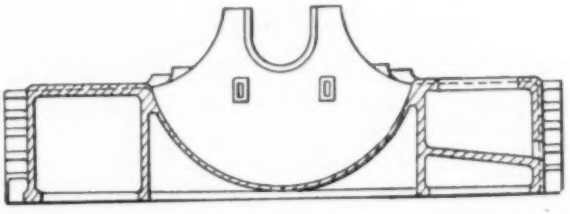


Fig. 1

Fig. 2



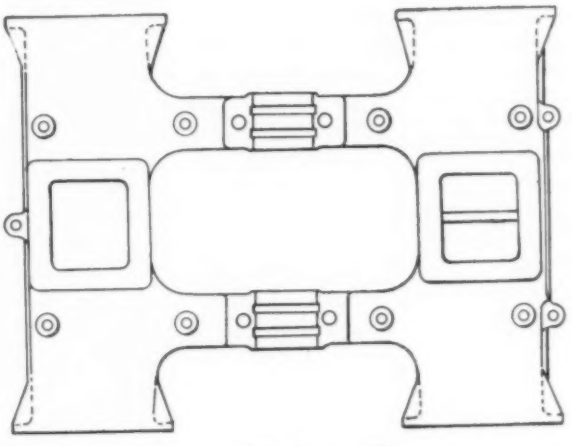


Fig. 3

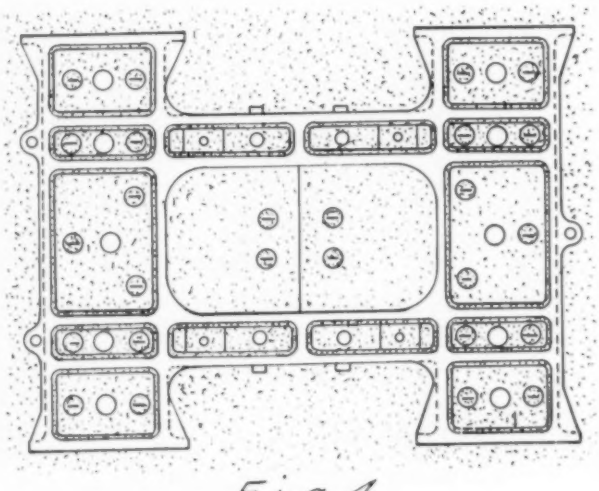


Fig. 4

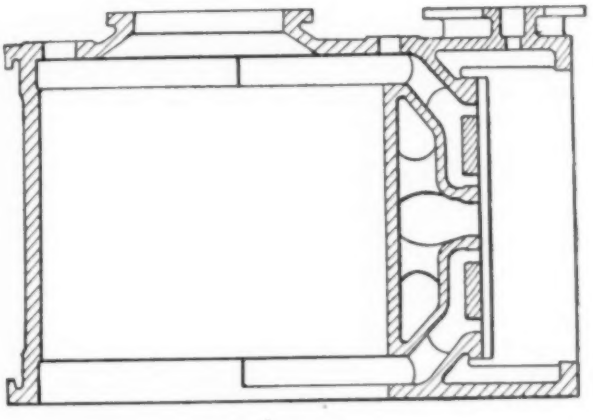
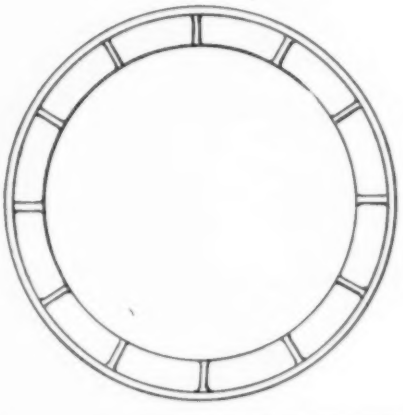


Fig. 5



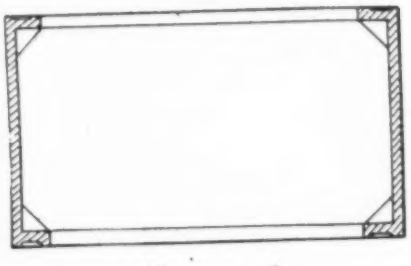


Fig. 6

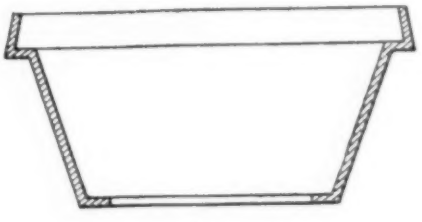


Fig. 7

FIGS. 1, 2 AND 3 ILLUSTRATE COMMON TYPES OF BEDS IN WHICH THE CORES REST ON CHAPLETS IN THE BOTTOM. FIG. 4—THE CORED MOLD. FIG. 5—CASTINGS OF THIS TYPE CAUSE TROUBLE ON ACCOUNT OF UNEVEN SHRINKAGE. FIGS. 6 AND 7—TYPICAL FORMS SUITABLE FOR SWEEPING IN LOAM

iable shrinkages. When such work is being repeated these effects can be countered, but occasional castings give trouble. The setting and securing of the massive cores, and some cores in others, gave trouble, rendering it difficult to work within ⅛-inch limits.

This example is typical of an extensive group of castings in which the body and central core are swept up in loam, the remainder being formed with pattern attachments, the interiors of which are taken out with dried-sand cores, rammed in boxes. The amount of detail involved is large and varied and in consequence of the large number of parts, the chances of errors creeping in are multiplied. Always such cylinders are molded and poured with the axis vertically. In this example it hardly matters which end is uppermost. The slightly better way is to mold it as it stands, with the open mouth of the cylinder down; but they also have been made in the opposite position. Although the body is swept in loam, the amount of pattern work is large and the core boxes are numerous, entailing the preparation of all those portions which are extraneous to the cylindrical body. The pattern parts are set by measurement. The cores usually are set in a similar manner.

Cylinder bodies, as in the example, Figs. 5, 8 and 9, are made in loam because the patterns are too large to be constructed economically from lumber. An alternative method where several castings are required is to make the body in skeleton fashion, that is, with narrow strips, leaving open spaces of about the same width between the strips. These are filled with sand, to produce a continuous surface, against which the loam is daubed, or a dry-sand mixture rammed. The extraneous pattern parts are made complete as just stated, but they are attached to the skeleton cylindrical body, with no risk of becoming displaced, as they might be if laid in loosely against a loam body.

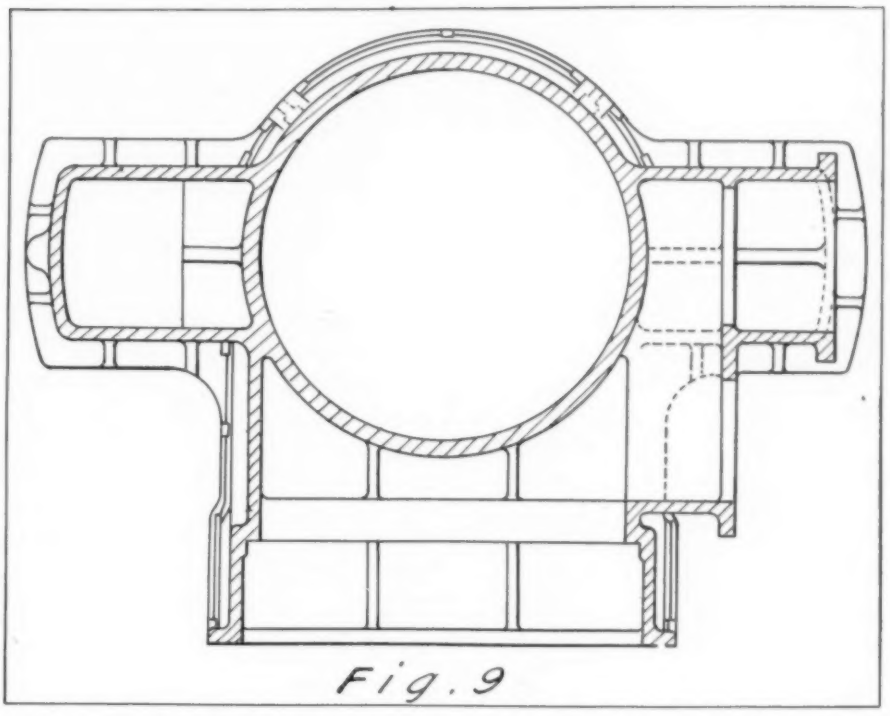


FIG. 9—CASTINGS OF THIS DESCRIPTION ARE SUBJECT TO DISTORTION AND SOME PARTS WILL COME OUT APPROXIMATELY THE SAME SIZE AS THE PATTERN

Sweeping a Mold

The general question of sweeping molds in loam is one that often arises. The method reduces the patternmaker's work to a minimum, but it throws much more on the molder. The method receives favorable consideration where the dimensions are too large to permit the more costly lumber construction. After this consideration comes that of simplicity, or intricacy of outlines. If symmetrical, the more elaborate the contour the stronger is the case for sweeping.

Figs. 6 and 7 show typical forms suitable for sweeping in loam. Fig. 6 is a foundation cylinder, required in fairly large numbers, and ranging say from 3 feet to 6 feet in diameter. The thickness is small in proportion to size, from 1 inch to 1½ inches. This is a clear case for loam. Pattern brackets have to be bedded in. The pan in Fig. 7 is a similar example. Loam molding alone would be considered for this. The work is simple and no additional pattern parts are required. In neither case could the building up of a pattern in segments be considered. Skeleton patterns made of longitudinal strips would be the only alternative of a practicable kind, but these would be too weak and liable to become distorted in ramming. In many cases patterns are swept up in loam to be molded from like those of wood, but rarely when of large diameters. They seldom exceed 2 feet 6 inches in diameter, and usually are smaller. Such patterns are economical when one, or a few molds only, are wanted, for which a wood pattern would be too costly. Frequently pattern attachments of nonsymmetrical fittings, or of portions too flimsy for loam have to be added to them. A loam pattern will survive several moldings.

A frequent cause of disagreement between patternmaker and molder, is whether molds shall be made in green sand from complete patterns, or

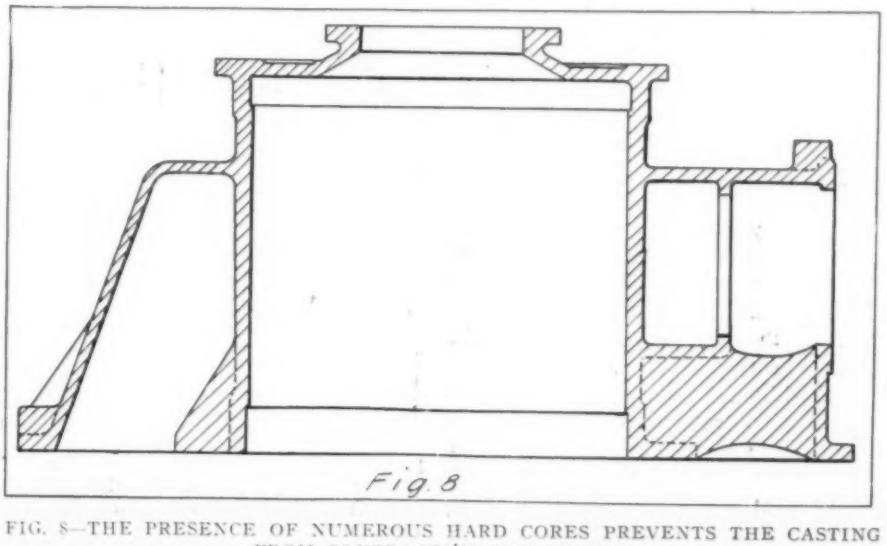


FIG. 8—THE PRESENCE OF NUMEROUS HARD CORES PREVENTS THE CASTING FROM CONTRACTING UNIFORMLY

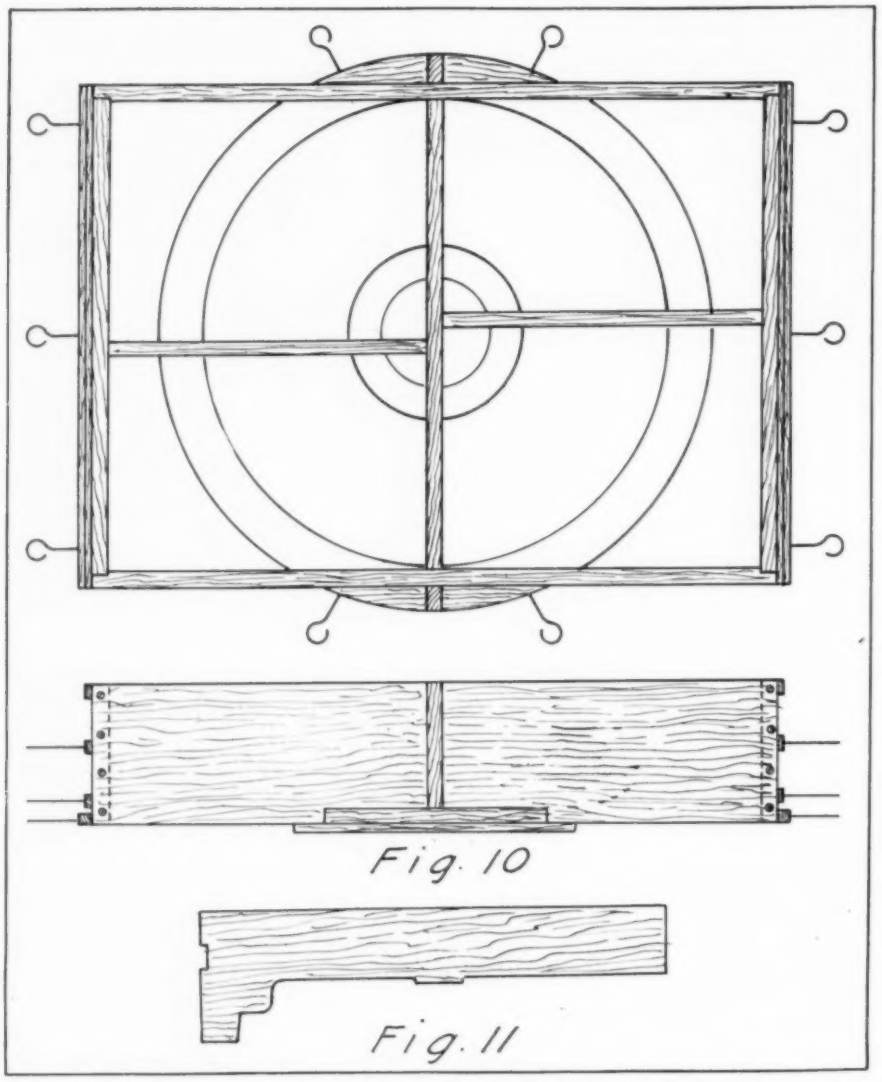


FIG. 10—EXAMPLE OF A SKELETON PATTERN COMMONLY EMPLOYED IN THE MAKING OF SOME DESIGNS OF BEDS FIG. 11—SWEEP EMPLOYED TO FORM A RING ON THE BED BEFORE LAYING DOWN THE PATTERN

whether skeleton parts with sweeps and striking boards shall be used. Often the sequel is seen in the machine shop; since it is obvious that when molds are prepared without complete patterns, they will be more liable to variations than those that are made from complete patterns. Many little errors creep in when skeleton patterns, or sweeps, or striking boards with loose details are used. So much measurement is required on the part of the molder, and results depend so much on the accuracy of his tackle that errors are liable to occur.

Fig. 10 is an example of a skeleton pattern commonly employed in the making of some designs of beds, and typical of others. It is a mere outer frame, stiffened with interior bars, and carrying only those attachments which belong to the exterior of the casting. There is nothing to indicate the shape of the interior, which is formed with cores. In many instances a vast amount of lumber and pattern work are saved. If bosses or facings are in the top, they have to be rammed in a plain top and set by measurement. If they are numerous, the top of the skeleton pattern sometimes is boarded all over to receive the fittings, and the cope is rammed on that. Should fittings be required in the bottom, they are set by measurement. The only addition here is an annular facing to receive a ring of teeth, and a boss. These are swept with the board shown in Fig. 11, before the skeleton frame is laid down.

The only preparation required before the pattern frame is laid down is that of a rammed, leveled, and vented bed which is to form the bottom face of the mold and on which the cores are to be set by measurement alone without print impressions. The sand is then rammed around the pattern and struck level with its top edge to receive the cope.

It is not necessary in all cases to have a complete skeleton frame. A

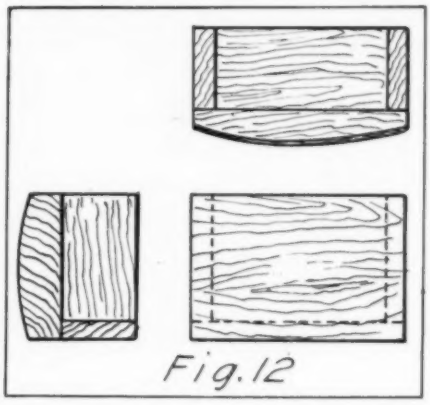


FIG. 12—SEGMENT PIECES SOMETIMES USED FOR MAKING CIRCULAR BEDS

circular bed could be swept with a segmental piece, Figs. 12 or 13, worked round on the sand bed which had been previously leveled. Lugs or other exterior attachments are set in by measurement. The sweep is loaded with a weight during ramming; set on top, in Fig. 13, in the recess in Fig. 12. The interior is formed with cores.

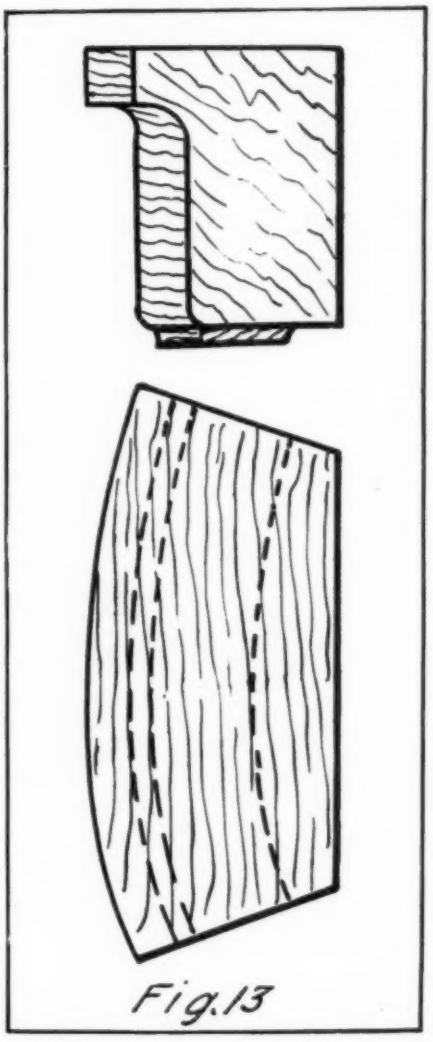
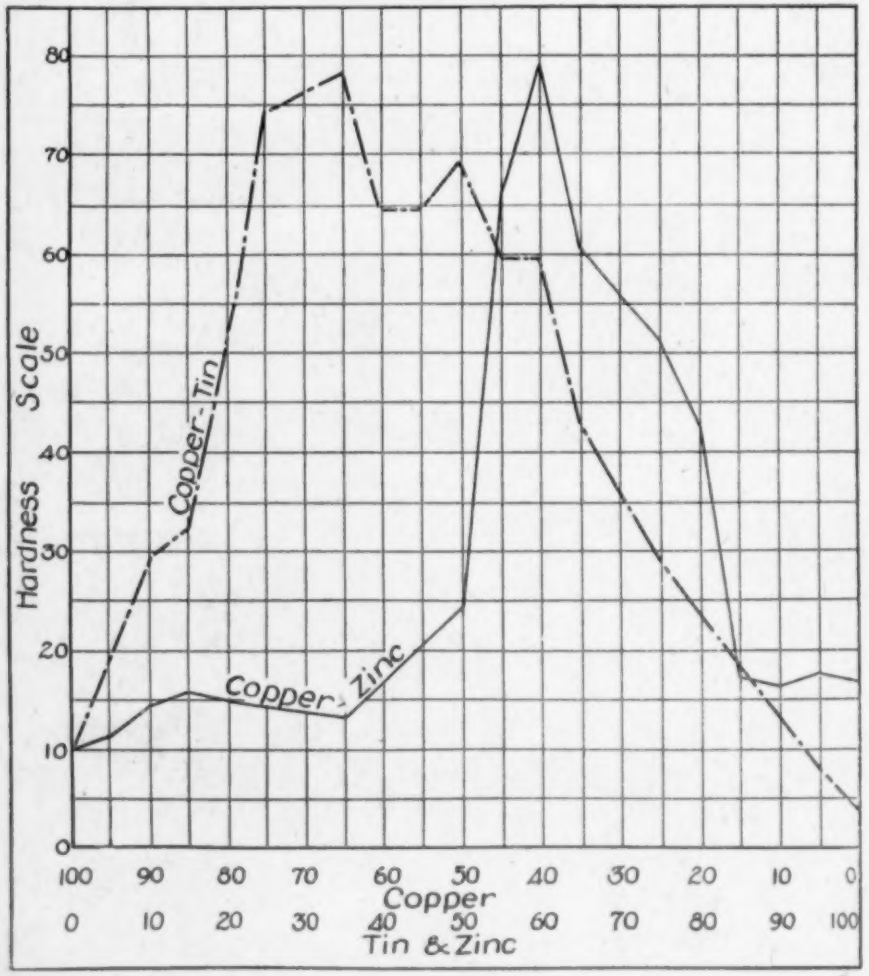


FIG. 13—THE SEGMENT IS USED TO FORM THE OUTSIDE OF THE MOLD AND DRY-SAND CORES FORM THE INTERIOR

HARDNESS CURVES FOR COPPER-TIN AND COPPER-ZINC ALLOYS

By George K. Elliott



Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

APPROXIMATE ANALYSES OF TIN

Following are approximate average analyses of representative brands and grades of tin.

	Tin	Anti-mony	Arsen-ic	Lead	Bis-muth	Cop-per	Iron	Sil-ver	Sul-phur	Co-balt
				0.010 to	0.010 to					
American S. & R. Electro-lytic	99.900 to 99.960	nil	nil	0.013	0.003	trace	nil	nil	nil	....
American S. & R. Smelter tin	99.000 to 99.250	impurities vary considerably								
Banka	99.950	0.007	nil	trace	nil	0.018	0.045	nil	trace	....
Billiton	99.960	0.006	nil	nil	nil	0.023	nil	nil	nil	....
Penang	99.939	trace	0.013	trace	nil	0.016	0.028	nil	0.004	....
Singapor	99.870	0.008	0.045	0.034	0.003	0.052	0.003	0.006	0.005	....
Mt. Bischoff*	99.795	0.015	0.063	0.037	0.005	0.035	0.042	trace	0.008	....
Pyrmont	99.938	0.017	0.019	trace	nil	0.022	trace	nil	0.004	....
Irvine Bank	99.580	0.062	0.034	0.221	0.025	0.126	0.002	0.018	0.004	....
Williams, Harvey, No. 1.	99.860	0.015	0.010	0.004	0.005	0.047	0.003	nil	0.006	....
Williams, Harvey, No. 2.	99.560	0.166	0.037	0.162	0.007	0.050	0.005	trace	0.013	....
Williams, Harvey, No. 2a	99.350	0.245	0.065	0.223	0.015	0.042	0.016	trace	0.013	....
Williams, Harvey, No. 3.	99.200	0.300	0.037	0.396	0.007	0.100	0.013	0.014	0.006	....
Williams, Harvey, No. 4.	99.941	0.011	0.022	trace	0.001*	0.020	trace	trace	0.005	....
Penpoll, No. 1	99.720	0.118	0.054	0.041	0.007	0.052	0.004	0.009	0.007	....
Penpoll, No. 2	98.710	0.569	0.042	0.546	0.055	0.103	0.007	0.015	0.004	....
Penpoll, No. 3	99.300	0.325	0.056	0.212	0.050	0.088	0.002	0.021	0.009	....
Redruth	99.160	0.176	0.053	0.177	0.017	0.445	0.041	0.006	0.008	0.012
Sutton, T., & Sons	99.550	trace	0.022	0.342	0.015	0.045	0.010	trace	nil	trace and loss
London Tin S. Co., refined	99.921	0.022	0.013	....	....	trace	0.030	....	0.004	....
Th. Goldschmidt, No. 1.	99.860	0.004	nil	0.102	nil	0.043	trace	nil	trace	0.016
Th. Goldschmidt, No. 2.	99.460	0.015	nil	0.425	nil	0.069	trace	nil	trace	....
Th. Goldschmidt, No. 3.	99.150	0.122	0.046	0.143	0.112	0.352	0.007	0.006	trace	....
Wing Hong, No. 1	99.343	0.031	0.040	0.434	0.007	0.052	0.010	trace	0.011	0.072
Wing Hong, No. 2	98.662	0.039	0.035	1.035	0.012	0.134	0.014	trace	0.011	0.058
Wing Hong, No. 3	95.280	0.381	0.050	3.995	0.020	0.106	0.026	0.018	0.008	0.116
*The directors of the company issue the following analyses:	99.847	0.015	0.015	0.042	0.001	0.017	0.063	....	....	....
	99.90	....	....	0.05	0.01	0.006	0.01	0.008	0.005	0.04
	99.88	....	0.022	0.025	....	0.027	0.038	....	0.004	0.004

From Quinn's Metal Handbook and Statistics.

THE FOUNDRY DATA SHEET, APRIL 1, 1922
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

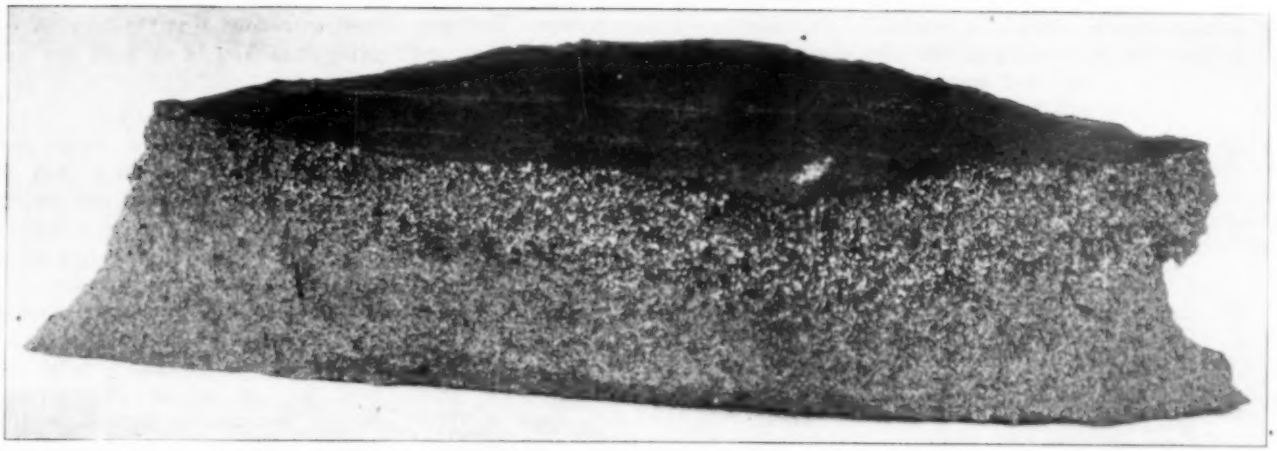


FIG. 1—THIS PIECE LAYS AS IT WAS CAST, WITH THE CLOSE-GRAINED STRUCTURE ON THE DRAG SIDE AND THE OPEN-GRAINED STRUCTURE IN THE COPE—THE SAME STRUCTURES WERE FOUND THROUGHOUT THE ENTIRE CASTING

Close and Open Grain in Same Metal

Fracture Shows a Distinct Line Between a Close-Grained and an Open-Grained Structure in a Gray Iron Casting—Metal with Open Structure Has Less Carbon

A DESCRIPTION of a peculiar structure found in a gray-iron casting has been given to a number of metallurgists who have stated that the causes for the structure are a mystery. This description is repeated here with the hope that someone will offer a theory which will account satisfactorily for its occurrence. The frame of a horseshoe-type was broken and it was found that the grain of the iron at the place of fracture was in two distinct layers. The one layer was of a fine grain while the other had a considerably coarser grain. Investigation showed that the same difference in structure obtained all through the casting. When the casting was shown to the manufacturer it was learned that it had been cast on its side and gated at both ends of the U from a single down gate. The two structures were of approximately equal areas, the line of demarcation running horizontally across the section of the casting as poured and near the middle. A fragment of the iron is shown in Fig. 1 with the coarse structure on top, as it was cast. The iron was melted in a cupola lined to 42 inches in diameter, in 1800-pound charges. No steel scrap was used, the mixture being made of pig iron and gray iron scrap. Although no record could be found to show when the casting was made, it may be concluded that the iron was caught from the cupola spout in a 150-pound bull ladle as that is the custom in the foundry which produced this unique casting.

The micrographs and analyses were made by the York Mfg. Co., York, Pa.

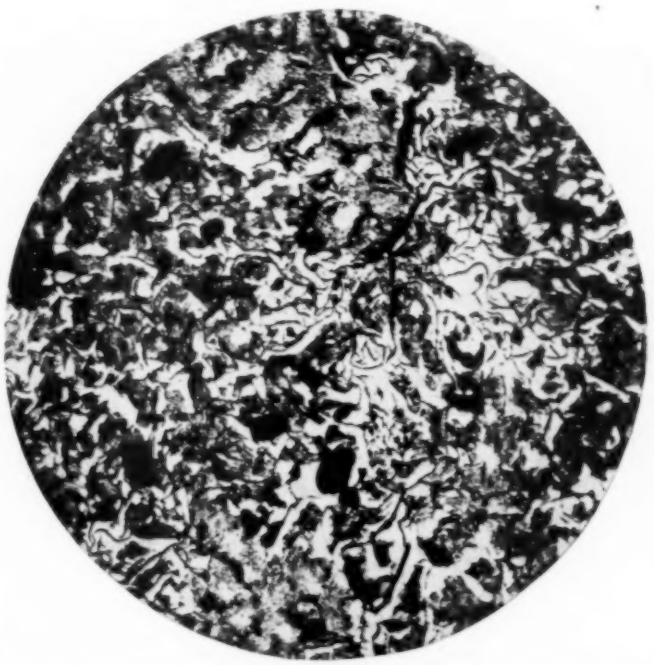


FIG. 2—MICROGRAPH OF THE CLOSE GRAINED STRUCTURE FIG. 3—TO THE RIGHT SHOWS THE OPEN-GRAINED STRUCTURE—BOTH MICROGRAPHS WERE MADE WITH 100 MAGNIFICATION

The micrographs shown in Figs. 2 and 3 illustrate the structure of two places in the casting not more than ¼-inch from each other. Both of these micrographs are characteristic of the structure they represent. They illustrate clearly the difference in size of the grain structure in the two formations.

Drillings were taken and analyzed for silicon, sulphur, phosphorus and manganese, with the following results:

	Sil.	Sul.	Phos.	Mang.
Open grain	2.90	.055	.241	1.28
Close grain	2.89	.054	.259	1.27

All of these elements with the exception of the phosphorus were practically in the same amounts in both structures. While the phosphorus was 0.018 per cent higher in the close grained portion than in the open grained area, the difference is so slight as to be inconsequential.

The next step was to secure a sample for carbon determination. Drillings first were taken and these were ground in a steel mortar until all passed through a 100 mesh sieve. This fine material was used for the sample and gave the following results:

Open Structure

Determination	First	Second	Average
Total carbon	2.80	2.80	2.80
Graphite carbon ..	2.23	2.22	2.22
Combined carbon			0.58

Close Structure

Total carbon	3.17	3.12	3.15
Graphite carbon	2.66	2.71	2.69
Combined carbon			0.46

These determinations show a variation both in the amount of combined carbon and in the amount of graphitic carbon. The sample with the close structure showed 3.15 per cent total carbon as against 2.80 per cent for the sample with the open structure, a notable difference of 0.35 per cent. Had the close structure been in the cope side of the casting, it might have been concluded that the iron on solidifying was unable to hold the carbon it contained and allowed it to float to the top. However, the larger percentage of carbon was in the metal on the drag side of the casting and being lighter than iron could not well have sunk after being released from the cope side. This might seem to indicate that the carbon content of the metal was the same before pouring as it was found in the casting and that the metal of the lower specific gravity sank to the bottom. Disputing this is the probability that little if any difference existed in the specific gravity of the two structures of metals, and the metal on top, with its lower carbon content would likely have been of a higher specific gravity than that containing the higher percentage of carbon had it not been of a more open grain. So far no plausible reason for the phenomenon has been advanced.

Details Causes of Blowholes in Castings

BY W. W. STORM

BLOWHOLES are the result of an outrush of gas from the core or mold materials, into the molten iron at the time of solidification. If the solidification has proceeded so far that the outrushing gas or steam cannot bubble through it and escape through the vents which should be provided for the purpose, it will be imprisoned in the castings, forming one or more holes according to the shape of the castings, and the quantity of the escaping gas. These holes may not be apparent on the outside, and quite often occur in a location where they do not particularly harm, but they are frequently located at some point where they are unsightly or greatly weaken the casting.

The gases which cause blowholes may come from three sources: They may be, and generally are, caused by the generation of quantities of steam from the moisture contained in the molding sand by the heat of the iron. In the case of dry-sand and loam castings, the quantity of steam generated is so insignificant, if the molds have been properly heated, that it gives no trouble. However, in the case of green-sand castings, the moisture present, and, therefore the steam generated, is quite large in amount, and special precautions have to be taken to prevent blowholes.

Abstracted from a report published by the Southern Metal Trade association.

When the molten iron is poured into a green-sand mold, all the moisture in the layer of sand immediately in contact with the iron will at once be transformed into steam. The depth of the sand layer so affected depends on the thickness and extent of the molten metal. The steam must either force its way through the molten iron in the form of a mass of bubbles, or else it must escape through the sand. To facilitate its escape, the mold is vented; that is, after the damp sand has been packed around the pattern by ramming it closely into place, a wire is thrust repeatedly into the mold, making numerous passages for the escape of the steam and gas. Obviously, one of these vent-holes cannot extend to every point in the layer of sand adjacent to the casting, so it is necessary that most of the steam and gas should force its way for a short distance through the sand before it can reach a vent hole. It can only do this when the sand is somewhat porous. If the sand is too tightly rammed, it will lack the necessary porosity, and even though it be usually dry and the venting carefully done, the casting will be full of blowholes.

The second cause of blowholes is the decomposition of the material used as a binder for the cores, and its escape in the form of gas into the iron at the time of pouring. It is impossible to prepare and bake a core in such a way that it will not give off large quantities of gas when the iron is poured; therefore, means must be provided for the escape of this gas. To do this, the cores sometimes are prepared with wax strips running through them. When the core is baked the wax melts, leaving passages known as core vents for the escape of these gases. If the core is of such form and so set in the mold that the gases can escape from these vents in an upward or sidewise direction, and leave the mold without forcing their way through the molten iron, no blowholes will result. Also, for smaller cores, a sharp sand with an oil binder, which forms a porous body, frequently is used.

A third source of blowholes is the entrapping of air in certain parts of the mold, and its mixing with the iron. This trouble is due to insufficient venting of the mold.

In the case of large and complicated castings, it is generally advisable to make dry-sand or loam castings, to avoid, as far as possible, the chance of blowholes. When the mold is large it is difficult to vent it thoroughly, and when the work on it extends over a period of three or four weeks, it is impossible to keep the vents from filling up; hence the general use of dry-sand molds for large castings. Often, for the sake of economy, fairly large and complicated pieces must be undertaken in green sand, and it becomes a matter of importance that they be so de-

signed that the molder will not be compelled to invite disaster by keeping his sand too wet, or ramming it too hard, and that there is no part of the mold which cannot be thoroughly vented.

Up to a certain point the wetter the sand is, the better it will stick, but it should not be any wetter than is necessary. The more tightly the sand is rammed the better its particles will cohere, but tight ramming and wet sand, while they make a solid and easily handled mold, invariably produces blowholes. If a pattern be of complicated form or hard to draw, or if, when it is drawn, it leaves the sand in such a form that the mold will easily fall together if there be a little jarring, the molder will be compelled to wet the sand more and to ram it harder than usual. Small, deep openings, sharp corners and thin walls and partitions of sand are especially troublesome. Not only do they make it difficult to draw the pattern, and handle the mold, and so make excessive wetting and hard ramming imperative, but they form places in the mold which the venting wire is unlikely to reach. Hence, they are to be avoided when possible in any class of molding, and on no account should such work be permitted in the case of large green-sand castings. When designing a casting to be made in green sand, the designer ought to know the position which it will occupy in the mold when poured. In general, the parts of a casting which lie in the bottom of the mold will be the soundest, and those parts which must be machined, or which require the greatest strength, should therefore, occupy the bottom of the mold, if possible, when the casting is poured. To insure a sound casting, the sand in the lower parts of the mold must be comparatively dry and loosely rammed. This condition generally is not difficult to attain, since all the work on the sand is done with the pattern in place, and that part of the mold is not generally moved or handled after the support of the pattern has been withdrawn. In the lower part of the mold, the sand is generally supported at all points in a thorough manner by the sand lying under it, and so hard ramming or wet sand is unnecessary. The upper part of the mold must of necessity be rammed harder than the lower part, since the sand is not supported from beneath but hangs from above.

It often occurs that the larger part of a casting is of simple form and easy to mold. A certain part of it, however, may be of a form exceedingly difficult to mold, and therefore likely to give considerable trouble. It is not necessary that the whole casting be made in a dry-sand mold, but a corebox may be made to take care of the difficult part of the work, even though the work would ordinarily be done without a core. It is just as easy, and often as desirable, to cast the external face of a casting against a core as the internal face. While it may not pay to do this when only one casting is wanted, it is often the cheapest method when a great many are required: it reduces to a minimum both the work of the molder and the chance of a spoiled casting. Forms can often be cast in this way which could not be cast by any other method.

How and Why in Brass Founding

By Charles Vickers

Blisters Occur Casting Copper Tuyeres

In casting copper tuyeres we have experienced trouble through the presence of blisters on the nose of the tuyere. The casting may appear sound, but a little tapping with the hammer will reveal the presence of the blisters. The mixture is copper, 99.5 per cent pure, which is melted in a 2000-pound, non-crucible furnace of the tea-kettle type, and when the copper is molten from 1 to 1½ per cent of phosphor copper is added. The molds are well vented, the dry sand cores have sawdust centers. The casting is gated at the bottom, as shown by illustration, and there is no riser. The castings do not leak, the only defect being the blisters. How is it the phosphorus makes the copper stay in the mold? The metal is poured at 2300 degrees Fahr.

If the sprue in the sketch correctly represents the height of the sprue in relation to the casting, then the blisters would be likely to disappear when the sprue is raised. As there is objection to the use of risers on the casting, increasing the height of the sprue is well worth a trial.

One guess is as good as another as to the cause of the blisters. One theory is to the effect that the mold fills with copper, and a thin skin is instantly formed by congelation next to the sand. Then the liquid portion at the highest part of the casting feeds away to the lower parts of the casting. When using phosphorus as a deoxidizer, one could predict that this would happen. The phosphorus makes the copper stay in the mold, because it acts as a deoxidizer. Without the use of some deoxidizer the copper cannot be cast, as it is filled with gases and would produce an aerated casting. The blisters might be stopped by chilling the nose of the casting. The theory of course being that instead of a thin skin forming as in the present instance, the entire thickness of metal at that point will set before the remainder of the casting.

Prevents Holes in Monel Metal Castings

We have considerable trouble with monel metal as the castings are filled with blowholes although externally they look good. We are adding 1½ ounces of magnesium to 100 pounds of monel metal. What should we do to overcome this difficulty?

The probability is that the magnesium is burning on the surface of the molten metal and is doing no good as a deoxidizer. Melt an alloy of 50 per cent copper and 50 per cent nickel, and add magnesium in the proper proportions to make an alloy containing 10 per cent magnesium. Then add 1 per cent of the nickel-copper magnesium alloy to the monel metal.

The melting point of monel metal is 2480 degrees Fahr., and it will have to be heated considerably above that point to run into molds and fill them. This is considerably beyond the temperature of the copper alloys, and approximates that of steel, therefore, a more refractory molding sand than the or-

dinary brass molding sand is required. If the latter is used it may be partially decomposed where heavy masses of metal come in contact with it, generating gases which produce holes under the skin of the castings. The same thing occurs with steel if a more refractory facing than ordinarily used in iron foundries is not used. For monel metal use a facing in which silica sand predominates, and see that the deoxidizer gets into the metal instead of burning away on the surface. Sound castings will then be obtained.

Improvize Melting Pot for Aluminum

We have a pattern to cast of aluminum that will require about 200 pounds of molten metal to pour, and have no furnace or crucible that will hold that much. We will probably melt it in an open fire, blowing with compressed air or a kerosene torch. Kindly let us know whether it would be advisable to turn the flame of the kerosene torch onto the top of the metal melting in the ladle. As it is unusual for us to pour such a heavy aluminum casting, we do not want to go to much expense in the matter.

It will be necessary to provide some vessel to contain the aluminum while it is being heated to the melting point, and as a crucible of sufficient size is not at hand, and a ladle must be used, the latter will have to be practically converted into a furnace of the noncrucible type. Use a large ladle well insulated with a refractory lining, and make a cover for the ladle, through which the oil burner can be inserted. Heat the ladle before the aluminum is charged therein. It will be necessary to turn the flame onto the metal, and a large ladle is required to provide the space for a proper combustion of the oil. After the aluminum is melted, flux with a small amount of zinc chloride before pouring.

It would not be advisable to try to melt the aluminum in an unlined wrought iron ladle, by heating the exterior of the same, as the aluminum would eat through. It could be melted in a cast iron vessel of sufficient size by surrounding it with brickwork of a temporary nature, and either solid or liquid fuel could be used. It would probably be cheaper in the end to send the pattern to some foundry having facilities for casting this amount of metal.

Manganese Addition Acts as a Deoxidizer

We would like to secure a proper mixture of hard bronze to be used for the several wearing parts of centrifugal pumps, which must be machined. We are pouring our castings of copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead 5 per cent. Would the addition of manganese give use a harder metal?

We suggest the following nickel bronze be used:

	Pounds
Copper	84
Nickel	2
Tin	8
Zinc	2
Lead	4
Total	100 pounds

The addition of manganese to 85-5-5-5 would result in drossy metal unless the manganese content is extremely low—so low the manganese merely acts as a deoxidizer. About 4 ounces of manganese copper containing 30 per cent manganese would be the correct amount to add. Nothing could be expected from this addition, provided the alloy has been properly made, and no difficulty should be experienced due to porosity. The manganese will promote soundness, and not hardness, when not used in sufficient amount to make an alloy. In the case of the harder alloy given, the addition of 4 ounces of manganese copper in place of 4 ounces of ordinary copper would be in the nature of an improvement, as it would act as a deoxidizer.

Bronze Melting in the Cupola Furnace

We would like to know what other people's experience has been in regard to casting bronze from the cupola. Our problem is to cast "flat backs" weighing about 300 pounds each, and our crucible furnace will not produce this amount of metal. We have a standard iron-melting cupola of 3 tons capacity. The bronze will be 90 and 10 or 95 and 5, and we will cast about 4 tons per day.

In melting bronze in the cupola, use a low sulphur coke, and as it will be necessary to melt copper to make the bronze, about the same amount of coke will be required as for a similar charge of cast iron, as the melting points of copper and cast iron are not far apart. One believer in cupola melted bronze puts in 800 pounds of coke for the bed, then 1500 pounds of copper, then about 150 pounds of coke, then 1000 pounds of copper, and continues this until tired.

Some people believe in wrapping the copper in a blanket of charcoal, and this seems sensible when there is a plentiful supply of charcoal. Tap into a large ladle and mix the metal there. The melting ratio of the cupola for cast iron will guide the melter in adjusting the coke charges. After the copper or bronze is down, get it out of the cupola by tapping into a large red-hot ladle. To make the alloy, it will be necessary to charge a definite amount of copper in the cupola, then to tap it all into a mixing ladle, containing the melted tin, and about 0.10 per cent of phosphor copper as a deoxidizer.

Bearing Alloys for Use in Rolling Mills

We desire to learn the bronze formula best to use for a bronze bearing weighing about 100 pounds, that is used in a rolling mill where the only lubricant applied is cold water. The metal that passes through the mills is at a welding heat and a continual stream of water is used on the necks of the rolls, and in the absence of grease as a lubricant we are puzzled as to the proper alloy to use:

Bronze rapidly loses its strength at temperatures above normal, at a dull red heat any copper tin alloy can be broken into pieces with a few blows as every brass foundryman knows. Because of this property he is enabled to break up scrap castings too large to handle for remelting entire. Dewrance found that additions of lead increased the tensile strength of bronze at temperatures above normal, although others have disputed this. In any event lead will improve the bearing qualities of the alloy, without seriously decreasing its strength at the temperature to which it will be exposed. The most suitable alloy to use in this case it would appear is as follows: Copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent. If this alloy breaks and fails, use an aluminum bronze of 10.50 per cent aluminum with about 1.50 per cent of iron, and the remainder copper. This alloy will be tough at a dull red heat; and as far as bearing qualities are concerned, it is doubtful whether at that temperature there will be much choice between any alloys having a base of copper.

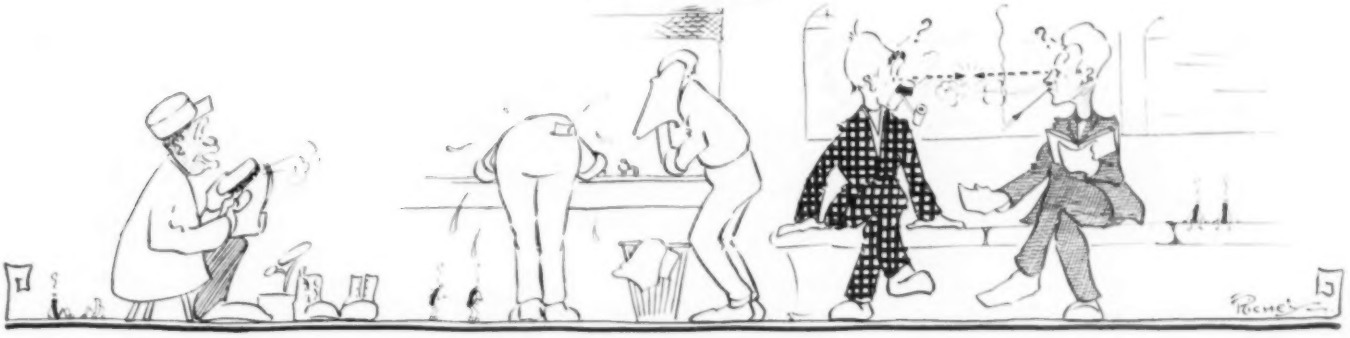
Aluminum Mixture for Pressure Cookers

We would appreciate any information you may be able to give us in regard to an aluminum formula, suitable for casting pressure cookers.

An alloy largely used for pressure purposes contains 12 per cent of copper, and 88 per cent of aluminum. Another alloy that it is claimed possesses pressure resisting qualities, consists of aluminum 96 per cent; copper 2 per cent, and magnesium 2 per cent. This latter would be a stronger alloy for castings of thin section than the one containing 12 per cent copper.

Bill On Pattern Mounting Methods--V

BY PAT DWYER

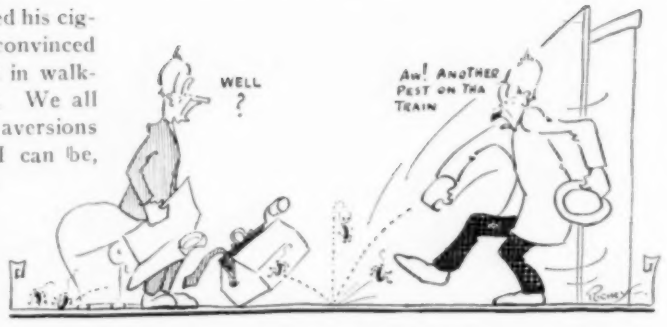


ENTERING the smoking compartment of a Pullman the other night with the object of enjoying a quiet draft of the weed before turning in for a few hours' sleep. I found the only other occupant to be a dapper gentleman seated in one corner smoking a cigaret supported in a holder about as long as an ordinary ½-inch lifter. I am not one who counts that hour lost in which he has not held converse with his fellowman and, therefore, I made no overtures toward starting a conversation. I kicked a cuspidor within easy range and having filled a reliable old corncob pipe, settled back on the cushions and, as our physical culture friends say, relaxed. Notwithstanding the villainous smell from his cigaret smoke, I almost had classified him as a kindred spirit when he aroused my worst suspicions by inquiring in a deep bass voice if I had heard of a recent railroad wreck on the division over which we were scheduled to pass that night. I admitted, modestly, to having read the head lines in the papers covering the event and then just to see whether he was a human being or a fish, which of course was exceedingly rude, but you know what I mean,—I repeated the ancient wheeze to the effect that I did not own the road and therefore what should I care whether the train was wrecked or not. Apparently, he considered the levity ill timed, for he pulled a little book out of his pocket and briskly proceeded to read an alarming list of figures purporting to show how many people are killed and crippled on the railroads every year. I was minded to tell him that I should not grieve if one more was added to the list; but on second thought decided that he might not appreciate my personal interest,—some people are queer that way,—so I allowed him to ramble along. From the accident pages he passed to others showing the number of damage claims allowed and the amount collected by survivors and by the next of kin to non-survivors. Having reached this—to him,—interesting stage, he asked me if I had any idea of what part of this vast amount had been paid, and paid cheerfully, by the company which he at the moment had the honor to represent. I confessed that my stock of ideas was at low water, so to speak, and that insofar as the amount of money paid to other people, total strangers, was concerned I was not even mildly interested.

"My dear friend",—a totally unwarranted form of address, I considered,—he said: "Don't you realize that every time you travel on a railroad train, steam boat, street car—electric, cable or horse drawn—omnibus, taxicab or automobile, or any other form of vehicle employed by the public and coming within the meaning of the phrase public conveyance, you actually are flirting with death in its most sudden and imminent form. As the good book says: 'we are here today and gone tomorrow,' and while it undeniably is true that the statement first was made at a time when railroads were an unknown quantity, there is nothing to show that the inspired writer did not have the modern Moloch in mind when he made the prophetic statement. War, pestilence and famine, were the recognized agencies in the good old days for thinning out the population in the same manner that the farmer thins out a field of turnips. They also furnished the late Mr. Malthus a slight measure of consolation pending the adoption of his famous scheme designed to prevent the population from crowding each other to the jumping off place at the four corners of the earth. I have figures here to prove unequivocally and beyond peradventure of a doubt, that a greater number of people were killed and permanently injured on the railroads of this country during the period of the war than the entire casualty list of the American expeditionary force during the same period. I have a proposition here by which a trifling payment will indemnify you in proportionate degree for the loss of one or both hands; one or both feet; one or both eyes; permanent or partial disability which would incapacitate you from the performance of your usual duties and a really handsome and generous sum to be paid to your legal heirs in the event that you are killed outright.

"Only the other day I sold a similar policy to a man about your size and build. He was not particularly enthusiastic, but finally decided to try it as an experiment. Today, my friend",—here he leaned over impressively, removed his cigaret and let me have the full benefit of a breath that apparently had crawled in between the partitions and died probably a week previously,—"Today, my friend, that man's name heads the list of those killed in the accident to which I directed your attention a few minutes ago." By the exercise of truly Christian fortitude I restrained myself from an almost uncontrollable impulse to tell him he should collect any insurance he had outstanding on his breath before the remains had decomposed be-

HE COMES UP BETWEEN STATIONS FOR AIR



LITTLE JOURNEYS TO THE HOMES OF OUR READERS

yond identification. He resumed his cigaret and blew a puff or two that convinced me that any person is justified in walking a mile to escape the odor. We all have our peculiarities and pet aversions and when it comes to smell I can be, like cousin Egbert, pushed just so far. I backed away as far as possible to indicate according to rule 6, *The Complete Book of Etiquette*, that I no longer was interested in his conversation. Apparently he was not familiar with this standard piece of literature for his gills continued to open and close automatically and he began to undulate gently in my direction. Realizing that stern and drastic measures were required I decided to give him the gaff and lift him out of his native element. I regretted that Bill was not present with his landing net to make a finished and workmanlike job of the thing; but resolved to do the best I could under the circumstances.

"Listen" I said. "Suppose you give your ears a little exercise lest they atrophy, shrivel, dry up and drop off for want of use. Without any excuse, justification or provocation you have taken up half an hour of my time which I might have employed profitably in considering personal problems of my own. The exercise of a little ordinary intelligence should have suggested that there is a time and a place for everything and even an inkling of the rules on which ordinary courtesy is based should have made you preface your own conversation with an intimation that you wished to make me a business proposition. Instead of approaching me in a straight forward manner and affording me the opportunity of indicating whether or not I had the time to place at your disposal you come slinking and sliding up along the side lines enveloped in a smoke screen, literally and figuratively, that would stall a motor in a glue factory. I don't like your manner, your proposition or your personality. Strictly between ourselves as one man to another I think you are a considerable nuisance."

It was a perfectly good effort wasted; for apparently it had no effect so far as penetrating his rhinocerous hide was concerned. He removed the cigaret holder, waved it gently and deprecatingly to-and-fro, said that he had a feeling I would some day in the near future bitterly repent that I had not favorably considered his proposition. I said no more, but continued to favor him with a fair imitation of what is known in the foundry, and probably elsewhere, as a hard look. You know the kind of a look the old man gave you in your apprentice days when you attempted to put up an alibi for pouring a job short. I won't go so far as to say that I can throw into a look the same venomous intensity as some of the old masters, but in this instance it served me in good stead. The enemy was routed, but he retired in good order with banners flying and with pipes skirling bravely. He paused at the door of the compartment long enough to say:

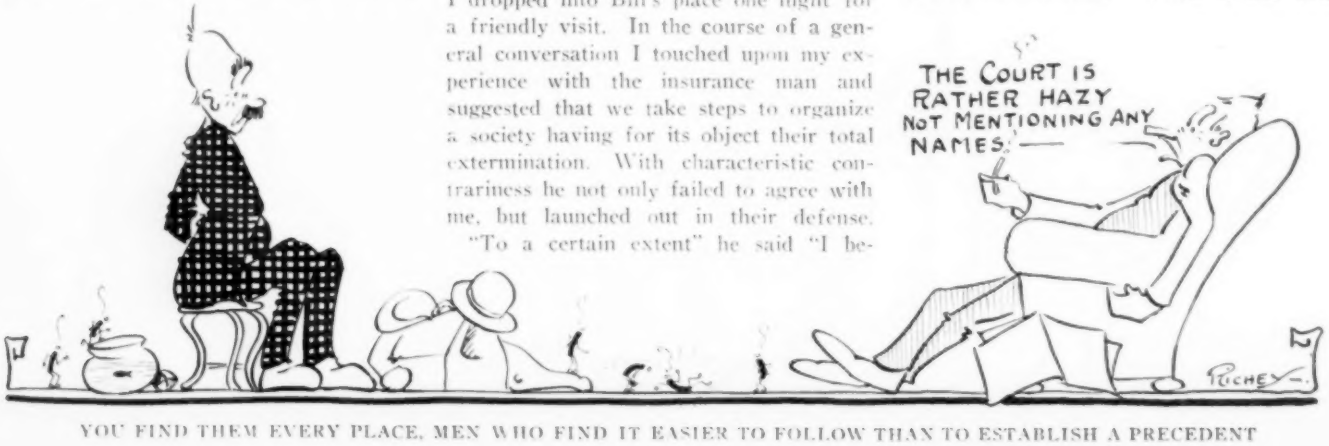
"Since plain speaking appears to be your favorite indoor sport, it is my private and personal opinion that you are a nut, a peanut, a pariah, an outcast in the vegetable kingdom and unless you want to be reckoned a total loss by your family, if you have one, you will lose no time in taking out a policy that will protect you from the combined attacks of the squirrels and the ivory hunters."

Shortly after my return from the trip, which contrary to the expert's opinion, and probably earnest hope and expectation, proved entirely free from disaster, I dropped into Bill's place one night for a friendly visit. In the course of a general conversation I touched upon my experience with the insurance man and suggested that we take steps to organize a society having for its object their total extermination. With characteristic contrariness he not only failed to agree with me, but launched out in their defense.

"To a certain extent" he said "I believe you are right and I have met several individual members who should be exterminated in the interests of peace on earth and good will to men. If I had my way, there is nothing I can imagine that would afford me greater pleasure than to slide a few of these birds through a sheet mill or massage them gently under a steam hammer. However, taking them as a class they have a legitimate place in industrial life and some of them are all right, regular fellows and believe me they have their troubles the same as the remainder of us. In fact in many cases, pioneering with a new product, or process, that eventually will be universally adopted, they meet with slight encouragement and in many cases with active opposition.

"A familiar example is the tardy recognition accorded the molding machine and in a somewhat lesser degree the apathy which characterizes the adoption of improved methods for mounting patterns for machine use. The type of machine, class of work and anticipated production are governing factors in the method selected. For long running jobs and under certain circumstances, the perforated plate in which a white-metal pattern is anchored to a rigid, cast-iron, back plate has proved eminently satisfactory.

"To make perforated plates it is necessary to provide one wood pattern frame and an iron master flask the size of the required plate. A good mold in which particular attention is paid to providing an exceedingly accurate parting, is made in the master flask. The pattern is removed and a narrow frame 5/8-inch thick, and 1-inch wide is laid all around the joint of the flask on the drag. The inside of this wood frame corresponds with the inside of the wood pattern frame. The mold is closed and poured with plaster of Paris. The plaster solution will shrink and will require to be fed with additional material. When it has set,



YOU FIND THEM EVERY PLACE, MEN WHO FIND IT EASIER TO FOLLOW THAN TO ESTABLISH A PRECEDENT

the cope is removed; the wood frame with the plaster cast taken out and washed clean. Vertical surfaces are scraped 3/16 to ¼-inch all over to provide room for the white metal when the back is cast in iron. The wood frame is removed and the outside edge of the plaster cut to fit the wood pattern frame. The combination plaster cast and wood pattern frame is employed as a pattern for making the perforated, cast-iron, back plate. After the cope and drag backs are made, the strip around the edge is machined down to within 3/16 to ¼-inch of the face of the frame. This will be the thickness of the white metal. Tapered holes in the back of the plates are cast in when the mold is made for the plate frames. This can be done by setting a number of ½-inch taper cores, 5/8-inch high, about 2 inches apart all over the face of the mold.

"After the plate frames are finished, a perfect mold is made from the pattern which is to be reproduced. In this instance, again, particular care is required to provide an accurate parting. The pattern is removed and the mold skin-dried. The cast-iron backs are washed with a mixture of kerosene oil and plumbago and then heated until they are hand warm. A 2-inch wood frame is laid on the back of each plate, fastened with four screws through holes in the frame. A sheet of paper is laid over the back to cover the tapered holes. The frame is rammed full of sand, scraped off flush with the top and four to six ¾-inch holes are cut through the sand over corresponding holes in the back plate. The same result may be secured by setting tapered gate pins in the holes before ramming the sand in the frame. Two of these holes are used for gates and the remainder for risers. The backing and plates are placed, each on its corresponding cope and drag, clamped and poured with white metal.

"A satisfactory mixture for this metal is 2 parts zinc, 4 parts antimony, 10 parts tin and 26 parts lead. The zinc and antimony are melted in one pot. Half the quantity of lead is melted in a second pot and all the tin is added after the lead has melted. The remainder of the lead is added to the mixture in the first pot and then a thorough composition is secured by pouring the contents of one pot into the other. At the proper pouring temperature the metal should scorch, but not ignite, a piece of newspaper. The metal is divided equally between two pots and the mold poured two-up.

"After the plates have cooled, the wood frames are removed and then the iron frames with the white metal pattern faces attached, are lifted off the master flask and taken to the pattern maker who finishes the face in the usual manner. The plates are bolted to the molding machine and a test mold made. Lycopodium or flour is dusted over the joint and the mold is closed and clamped. The mold then is taken apart and where it shows that the faces did not touch, the face of the plate is scraped until a final test indicates an even contact all over. The plates then are ready to go into production.

"An extra cope is made for a match at the time the first mold is made for the plaster cast. This is set aside to be used when making the finished mold in casting the white metal. In this manner the pattern location will be exactly the same and will insure an even thickness of white metal on the backs.

"The foregoing method applies particularly to patterns having an irregular parting line. Where it is possible to use split patterns or patterns in which the parting forms a straight line, the simplest and best method is to mount patterns on blank plates. This is done by making the pattern in two pieces, put together with two dowel pins and finished as a full pattern. Assuming that several small patterns are to be mounted together to fill a flask, one half is taken of each pattern and the group arranged in the required position on a blank plate. Holes then are drilled through the dowel holes in the patterns and through the plates. Suitable prick punch marks are placed on the plate and on each half pattern so that they may be relocated later. After they are marked the patterns are removed, the cope and drag plates are placed face to face and, using the first plate as a templet, holes are drilled in the second plate. The plates then are separated after which the first set of half patterns is placed on the first plate and the second set on the second plate and the dowel pins secured in each case. If necessary two of three additional holes are drilled for screws to hold the patterns in place. The heads of the screws and dowels are finished, the gate is attached to the drag plate and the sprue to the cope plate and then the plates are ready for the machine.

"With symmetrical patterns it is possible to arrange half patterns on one plate in such a manner that both cope and drag can be rammed on one plate. This involves a little more preparation but the process really is quite simple."

"Because a thing is simple" I said "It does not follow necessarily that the party of the second part can understand it. You probably remember the classical nursery tale describing the pathetic experience of Simple Simon when he tried to negotiate a little friendly deal with the pie man. It looked simple enough to him, but the hard boiled old pie pirate could not see it in that light."

"The point raised by our honorable friend in the low-crowned Derby," said Bill "is noted. The court is rather hazy in its recollection of the authority cited, but we shall look it up and if necessary translate our future opinion into words of one syllable for your benefit."

Chicago Society Hears First of Series

As the first number of an educational series by the Chicago Foundrymen's association, an address was made Wednesday evening, March 22, at the City Club, by Edwin S. Carman, chief engineer of the Osborn Mfg. Co., Cleveland, and the author of "Molding Machines and Pattern Equipment". The subject of his talk was "Economy of Machine Molding in the Average Jobbing Foundry" and the points of discussion were illustrated by lantern slides showing methods of pattern mounting and pattern making and the kind of flask equipment. Work was shown from a flask 24 inches square up to 8 or 10 feet square and 4 or 5 feet deep.

British Honor American Equipment Maker

At the annual dinner of the Manchester and District Ironfounders Employers association, Feb. 16, the response to the toast of the visitors was made by Franklin G. Smith, president of the Osborn Mfg. Co., Cleveland, in his capacity as vice president of the American Foundry Equipment Manufacturers association. The toast was proposed by W. B. Richardson. Oliver Stubbs, president of the Manchester and District Ironfounders Employers association and also of the Institution of British Foundrymen, occupied the chair.

Recent changes in the board of directors of the Norwalk Iron Works Co., South Norwalk, Conn., have resulted in the following executive staff: President and general manager, C. L. Thompson; vice presidents, Howard E. Adt, A. R. Betts and W. E. Mathews; treasurer and assistant secretary, Harold B. Knowles; secretary, Thomas M. Steele; chief engineer, G. W. Wardwell; and general superintendent, W. M. Greene.

Structure of White-Heart Malleable

Principal Characteristics Shown by Micrographs Which Indicate Whether the Iron Has Been Under or Over Annealed—Carbon Contents Determine Structure of the Unannealed Iron

BY RUDOLPH STOTZ

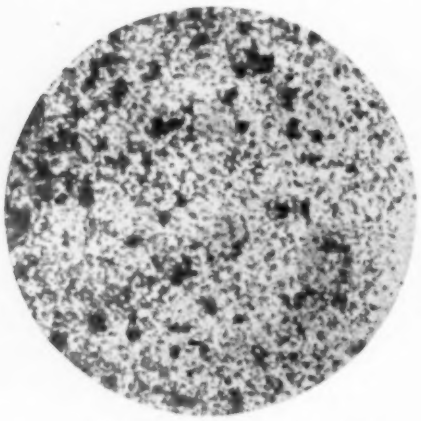
IN the practical production of malleable cast iron it is customary to test the quality of the annealed product by breaking sample castings as an index of their malleability, and examining the fracture with the naked eye. Microscopic examination also is resorted to and gives an important insight into the structure of the metal.

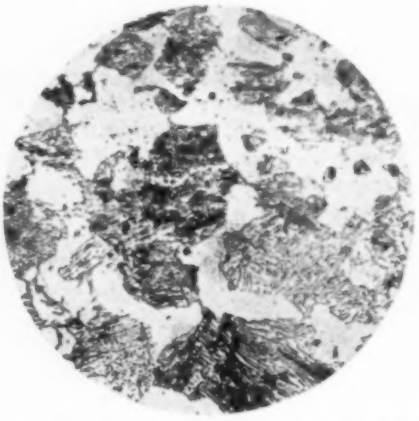
The iron has different microstructures according to its composition and the annealing time and temperature. When a soft tough casting of white-heart malleable is broken by bending the extreme outer portion possesses a somewhat fibrous structure particularly on the side which was in tension during bending. The core consists of uniform fine grains. This kind of fracture is characteristic of heavy decarburization and of considerable toughness. The resistance to impact of such a fine-grained piece is approximately 16.6 kilogram meters per square centimeter (775 foot pounds per square inch) when tested under impact. Under tensile test it shows a strength of about 52,000 pounds per square inch with 4 per cent elongation. The impact test is a good method of determining the most important property of malleable castings, namely, the toughness. The impact strength was determined by means of a Charpy impact machine. The test pieces were 1 centimeter square (0.391 inch square) in cross section and did not have the skin removed. They were broken in the unnotched condition on support 70 millimeters (2.756 inches) apart. The chemical analysis shows a combined carbon content of only 0.34 per cent at the center, that is, from drillings taken from a 0.118-inch diameter hole bored axially down the center of the cross section. All statements in this article concerning the carbon content of the core refer to the analysis of drillings from a hole drilled in this manner.

At higher magnification one sees, after etching the polished surface, that the extreme outer portion consists only of fine-grained ferrite, with only a small percentage of temper carbon. The inner portion is a mixture of ferrite and pearlite in which is also some temper carbon.

If the material has not been strongly decarbonized, whether intentionally or accidentally, the natural fracture will have at the center rather large, glistening, grains. The distribution of carbon in this section is shown in Fig. 1. The ferrite decreases from the edge toward the center so that the interior of the core consists only of the dark pearlite. Temper carbon is, of course, also present, and is recognizable in the form of small round black masses, which increase from the edge toward the middle. Such a piece tested under impact showed a resistance of 6.8 kilogram meters per square centimeter (317 foot pounds per square inch). The combined carbon content in the center was 0.84 per cent; the tensile strength on several samples ranged from 54,050 to 59,740 pounds per square inch and the elongation was close to 3 per cent.

Material which has been decarbonized to a lesser extent and therefore shows a higher strength but a lower ductility has in a natural fracture, four zones; one quite narrow, of fine-grained, almost fibrous iron, inside of which is one not quite so fine grained, being followed by a rather coarse brilliant circular zone surrounding a fine-grained core. The extreme outer portion consists of practically pure ferrite, the adjacent fine-grained zone of ferrite and pearlite, Fig. 2. The subsequent coarse zone Fig. 3 consists of pure laminated pearlite with considerable amounts of flocculent temper carbon. Finally, in the fine-grained zone are found crystals of free cementite near the clusters of temper carbon, Fig. 4, these crystals giving great hardness and brittleness. Nevertheless, this core is not difficult to machine, but should not appear in a casting of high quality which is designated as soft and tough. The combined carbon content at the point where these cementite crystals exist corresponds to that of an hyper-eutectoid steel, being in excess of 0.90 per cent. In the center of this piece it was 1.13 per cent. The impact strength of such slightly decarburized material is low, being from 2 to 5 kilogram meters per square centimeter (93 to 233 foot pounds per square inch), while the tensile strength is high, being between 51,200 and 68,200 pounds per square inch. The elongation is low,





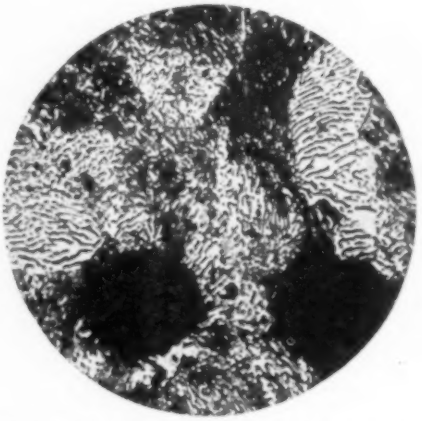
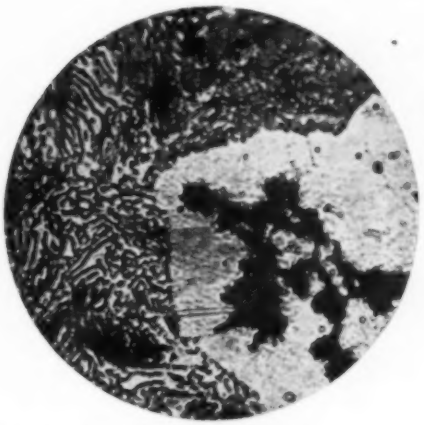


FIG. 1—DISTRIBUTION OF CARBON IN A SAMPLE NOT STRONGLY DECARBONIZED—X 25 DIA. FIG. 2—FERRITE AND PEARLITE—X 200 DIA. FIG. 3—LAMINATED PEARLITE WITH FLOCULENT TEMPER CARBON—X 200 DIA.



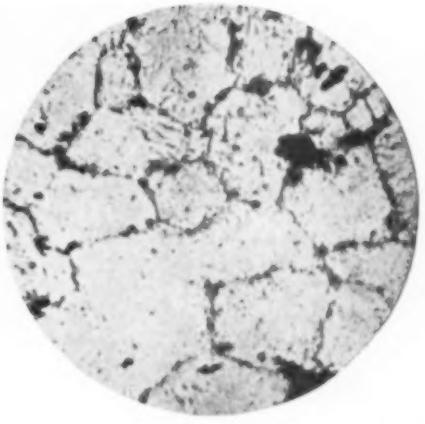


FIG. 4—FREE CEMENTITE AROUND TEMPER CARBON FIG. 5—CORE OF A PIECE OF ELECTRIC FURNACE IRON FIG. 6—NETWORK OF CEMENTITE IN AN INSUFFICIENTLY DECARBONIZED CASTING—ETCHED WITH PICRIC ACID—X 100 DIA.

generally 1 per cent, at the highest, 2 per cent.

These tests were made on cupola melted iron, which has the following analysis: Silicon, 0.65 per cent; sulphur, 0.23 per cent; phosphorus, 0.09 per cent; manganese, 0.18 per cent. As the carbon increases from the outer portion to the center, a greater or less extent, an average can scarcely be obtained. While the determination of the carbon content of malleable cast iron is of the highest importance for the purpose of estimating its quality, it is the amount of combined carbon which should be determined since the influence of precipitated temper carbon is usually negligible. The colorimetric method is the simplest for making this determination.

The principal structural constituents of malleable cast iron are ferrite. The fracture of white heart or European malleable cast iron varies from light to dark gray; the more temper carbon present the darker the fracture. Microscopic examination shows in the latter case a structure which consists of thick clusters of temper carbon embedded in a matrix of ferrite and in general the ferrite there is the lesser as the sulphur content of the iron, since sulphur strongly resists the decomposition of cementite into temper carbon and ferrite. An example is given in Fig. 5 which shows the characteristic structure of the core of a piece of electric-furnace malleable iron having; silicon, 0.80 per cent; sulphur, 0.06 per cent; phosphorus, 0.06 per cent; manganese, 0.19 per cent; taken at a magnification of 200 diameters. The impact strength of this material was 14.8 kilogram meters per square centimeter (690 foot pounds per square inch). Its tensile strength ranged from 54,050 to 62,580 pounds per square inch and its elongation from 8 to 4 per cent.

High Ductility Sought

High ductility or toughness is, in general, considerably more productive of high quality malleable cast iron than is high tensile strength. For this reason material which has been only slightly decarbonized, such as has been mentioned, and the structure of which is shown in Figs. 2 and 4, will not suffice where great toughness is desired. The core in these castings contains no ferrite, only pearlite, and this zone extends well toward the outside, but to secure ductility the core should have a certain amount of ferrite. If the chemical composition in the hard iron is properly adjusted and the iron has low elongation, either the cooling period was too short, the annealing temperature was too low, or the packing material contained insufficient oxygen to bring about the necessary decarbonization. Where faulty annealing has resulted in insufficient graphitization, under certain circumstances a network of cementite, Fig. 6, is produced. Naturally, such a material is brittle and has only slight resistance to impact. The less a specimen has been carbonized, the more cementite will separate at the center during cooling, so that finally a considerable aggregate of cementite may be present in the finished piece as shown in Fig. 7. Such a casting is hard in the center and can be drilled only with difficulty.

When the annealing has been especially bad, the final product may possess a glass-hard core surrounded by a thin skin or scale of soft decarbonized iron. The microstructure of the glas-hard core of undecomposed white iron, shown in Fig. 8 consists of the hard cementite and pearlite from decomposed austenite. Such material can scarcely be worked by cutting tools. This condition is more easily brought about when the silicon content

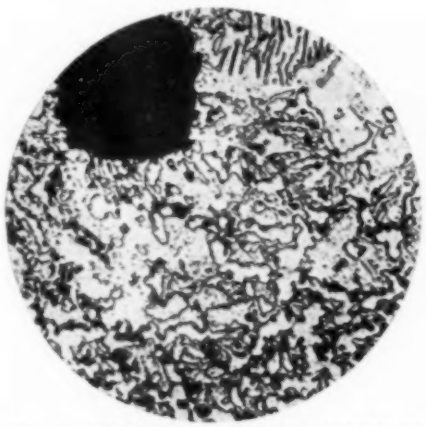


FIG. 7—CEMENTITE IN AN INSUFFICIENTLY ANNEALED CASTING—X 400 DIA. FIG. 8—CORE OF UNDECOMPOSED WHITE IRON—X 200 DIA. FIG. 9—CENTER OF AN OVER-HEATED SPECIMEN—X 100 DIA.

Carbon Varies With The Melting Process

Melted in	Silicon	Sulphur	Phosphorus	Manganese	Total carbon
Cupola	0.58	0.213	0.09	0.19	3.35
Crucible furnace	0.52	0.110	0.07	0.12	3.02
Reverberatory	0.86	0.080	0.08	0.18	2.65
Electric	0.92	0.064	0.07	0.16	2.35

of the hard iron is below 0.40 per cent. Such castings generally possess no toughness.

If the annealing temperature gets too high, castings are overheated and consequently brittle. This condition can easily be recognized by the appearance of the fracture which, particularly at the edge, shows brilliant, coarse crystals. These are made up of pure ferrite and may grow to astonishing dimensions. The interior, Fig. 9 also is made up of coarse crystals in which the ferrite has separated as large flakes which intersect at 60 degree angles as in the case of overheated steel. Material of this sort is not ductile and its resistance to impact is low according to the amount of overheating and decarbonization.

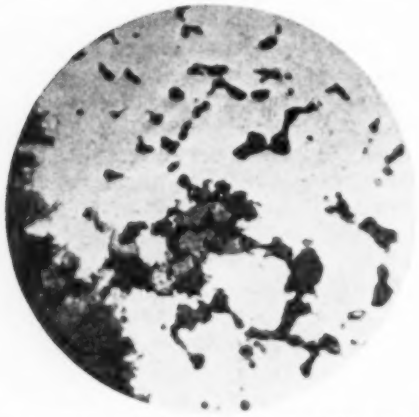
It happens in exceptional cases that the overheating has been so marked that the iron is burned, especially when the packing material is too rich in oxgen, or when atmospheric air has access to the castings being annealed. Such pieces possess a more or less thick hard crust of burned iron, part of which can be separated as a layer, part being removed by a chisel only with difficulty. However the action of the iron in taking up oxygen is not confined to the detachable crust but also penetrates to somewhat deeper layers so that in these sections there exist large quantities of iron oxide, and usually an enrichment of sulphur, both of which are visible in the unpolished section as respectively dark and bright contaminations as shown in Fig. 10.

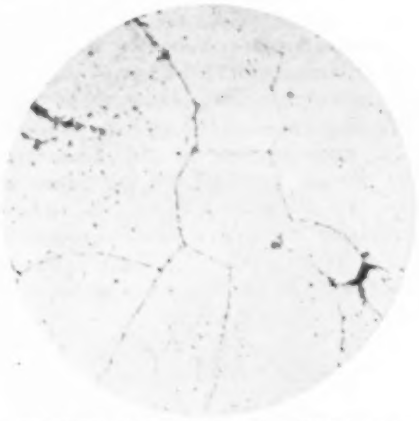
In connection with this burned iron there is a phenomenon bearing a certain similarity which should be differentiated and which I should like to call by the name *skinny iron*. This skin which, either completely or partially surrounds the castings to a depth of from 0.04 to 0.08 inches, is distinguishable from the weak crust of burned iron by being entirely smooth and not noticeable from the outside. It can be seen only when the casting is bent and broken. Since this skin is more brittle than the remaining part, it is partially torn off from the core by bending and therefore can be easily recognized.

Microscopical examination of this skin, when the specimen is unetched, shows it to be dotted throughout with dark spots which decrease in amount toward the center. They appear to follow the boundaries of ferrite grains and cause the unetched specimen to show large polygons, Fig. 11. It is assumed that the oxidation product of iron and also of its secondary constituents are formed through the penetration of oxidizing gases into the casting, these gases chiefly following the boundaries of ferrite grains. Pale yellow crystals of iron sulphide are frequently found between the skin and the core. Baumann's sulphur print showed strong segregation of sulphur in a thin layer between the skin and the core; a part of the sulphur probably having penetrated the skin along with the oxidizing gases. Chemical analyses furnish quantitative proof that the skin has a lower sulphur content than the core; for instance, the skin of a casting which in the unannealed state contained 0.25 per cent sulphur, may not have more than 0.1 per cent, while in castings of thin section, possessing deep skins, the core may have up to 0.60 per cent sulphur.

Almost all malleable castings show more or less skin. If one examines their extreme outer layer the so-called polygons may be seen more or less clearly formed in the unetched section by the point-forming products of oxidation. Fig 12 shows the delicately outlined polygons of such a skin. These polygons gradually becoming less distinct toward the center. Iron sulphide does not easily occur in the outer zone in the vicinity of oxide polygons, but a considerable enrichment of sulphur appears in the core. In a similar way, the penetration of sulphur is shown in Fig. 13, the specimen in this case having a rather heavy skin with a coarse polygonal structure of oxidation products. If the castings are more strongly oxidized the oxidizing gases penetrate individual ferrite grains so that such crystals have a border of the finely divided oxides as shown in Fig. 14.

In contrast to burned malleable iron, an ordinary stain shows beautifully laminated pearlite associated with oxidation products as shown in Fig. 15, or white crystals which as a result of their great hardness and dark coloring after etching with sodium picrate are shown to be cementite. The extreme outer portions of such castings are carbon free, while that part which is adjacent to the core contains carbon and is followed inside by a decarbonized zone. This phenomenon can be explained by assuming that a result of a drop in temperature during annealing the oxidizing reaction has been changed to a reducing condition causing carbon to be deposited from carbon monoxide gas according to the reversible reaction; $2CO=C+CO_2$, thus





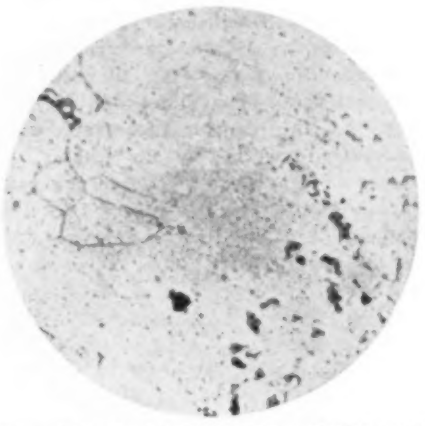


FIG. 10—IRON OXIDE AT THE EDGE OF A BURNED CASTING—UNETCHED—X 200 DIA. FIG. 11—SECTION OF A THIN SKIN WHICH SOMETIMES FORMS ON THE IRON—UNETCHED—X 100 DIA. FIG. 12—LEFT, EDGE SHOWING OXIDE POLYGONS—RIGHT, ENRICHMENT OF IRON SULPHIDE—UNETCHED—X 100 DIA.

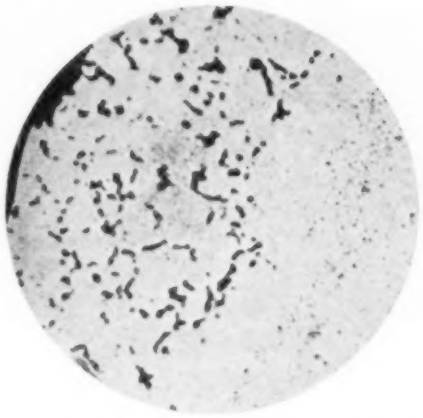
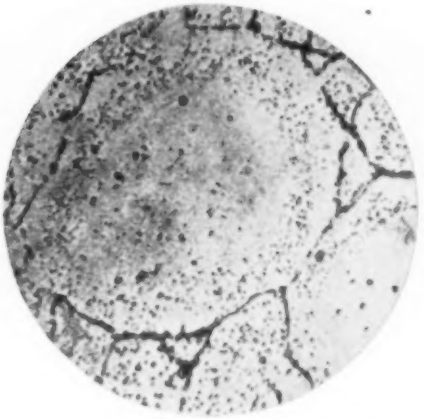
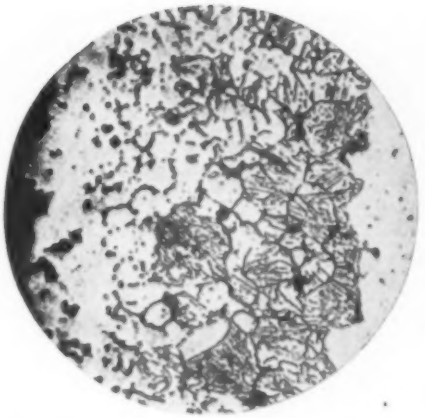




FIG. 13—LEFT, STRONGLY OXIDIZED SKIN—RIGHT, ENRICHMENT OF IRON SULPHIDE. FIG. 14—STRONGLY OXIDIZED FERRITE GRAINS IN SKIN—UNETCHED—X 200 DIA. FIG. 15—PEARLITE IN SKIN—ETCHED SLIGHTLY—X 200 DIA.

bringing about cementation. Study of the formation of this skin indicates that the action has been to strongly oxidize the outer layers of iron first, then reduce a part of the oxide so formed whereby some carbon is deposited from the reducing gases. This carbon shows in the finished casting as the cementite of pearlite. In this case the oxidized crust does not break off, as with burned iron, but the skin always contains sufficient metallic iron to give it a certain amount of toughness. A similar phenomenon is found in copper wire which always contains copper oxide. If under certain circumstances this oxide is reduced only to a certain depth by means of hydrogen the wire will show upon being broken the same skin formation as this malleable iron.

High Silicon Advantages

The most favorable chemical composition of unannealed malleable iron is considered here only insofar as it influences microstructure. It is customary to employ as high a silicon content as possible; that is, as high as possible without the formation of primary graphite. Silicon acts favorably upon the fluidity of iron and upon the subsequent annealing process, but the formation of primary graphite must be strictly avoided since the latter separates upon solidification in the form of thin plates which break up the internal continuity of the iron matrix. Since these graphite plates are practically unaffected by annealing, a casting which contains them will always be inferior.

If the unannealed iron contains only

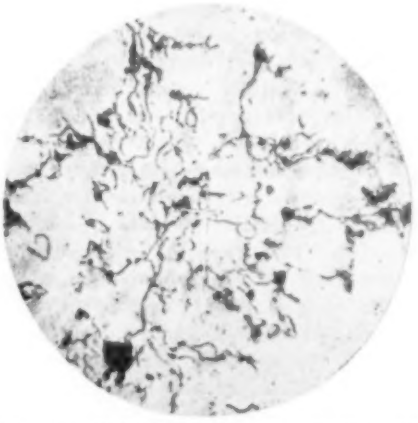


FIG. 16—CLUSTER OF GRAPHITE IN HARD IRON—X 100 DIA.

a little graphite, the physical properties of the finished piece will be only slightly affected, since, under such circumtsances, the graphite forms in little clusters which are separated and distributed throughout the material. The fracture of such a casting, containing a small amount of graphite, is shown in Fig. 16. However if the hard iron contains a larger amount of graphite detrimental graphite plates, as shown in Fig. 17, will be formed. It is known that these at the same time from nuclei to which the temper carbon that is produced in annealing readily attaches itself in the form of little nodules. Satisfactory determination as to whether or not an annealed casting contains graphite cannot be made, since now and then malleable castings are found of a normal silicon content which show veins or streaks similar to graphite, as indicated in Fig. 18.

Shrinks Reduce Strength

A high silicon content also is favorable to the avoidance of the so-called *black places* which are a serious evil for the malleable iron founder. These are more or less distinctly formed places caused by contraction, so-called *shrinks* into which well developed pine-tree crystals grow. Fig. 19 illustrates this phenomenon in the reproduction of the fracture of a tensile test specimen which, as a result of the shrink, showed a low tensile strength. The black color of these places existed in the unannealed specimen since the crystals show a dark tempering color.

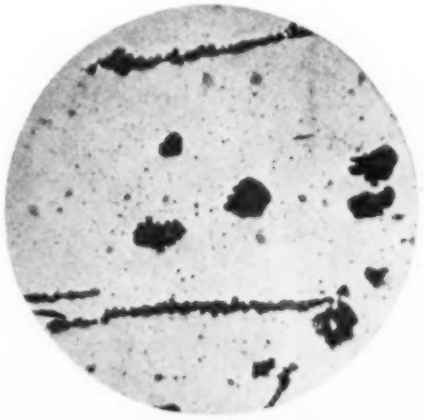
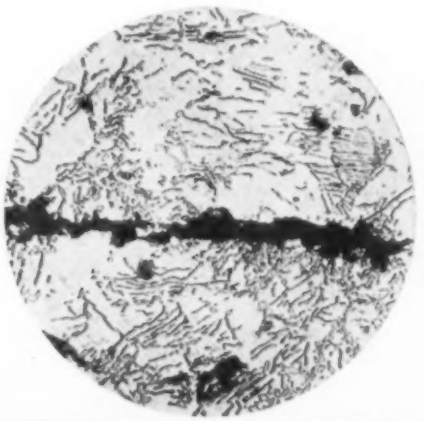



FIG. 17—ANNEALED CASTING WITH GRAPHITE—UNETCHED—X 100 DIA. FIG. 18—ANNEALED SAMPLE WITH GRAPHITE—X 100 DIA. FIG. 19—FRACTURE OF TENSILE TEST SPECIMEN, SHOWING SHRINKAGE—X 5 DIA.

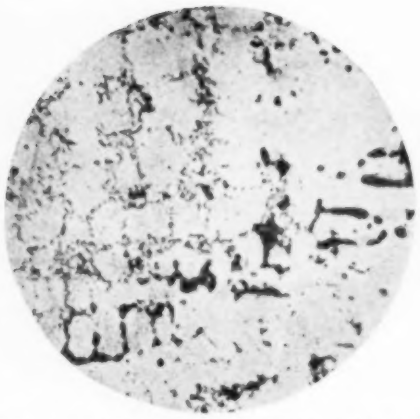


FIG. 20—SHRINK CONTAINING IRON OXIDE AND SULPHIDE—UNETCHED—X 200 DIA. FIG. 21—SHRINK, STRONGLY DEOXIDIZED—X 100 DIA. FIG. 22—WHITE IRON FROM THE CUPOLA—X 100 DIA.

During the annealing these black places increase considerably because of expansion, since the oxidizing gases penetrate into these porous zones more easily and rapidly oxidize, not only the carbon, but also the iron and form a large amount of dark oxide. Microscopic examination of such black places in annealed material shows a large amount of oxide in an arrangement corresponding to the pine-tree crystals originally produced, Fig. 20, while the ground mass is heavily decarbonized, Fig. 21.

Carbon exerts a strong influence upon the structure of unannealed irons. It should be kept as low as possible, but sufficiently high not to adversely affect fluidity and the formation of temper carbon during annealing. It is rarely possible to obtain a carbon content below 3.2 per cent where the metal has been melted in a cupola, while open-hearth and reverberatory irons usually contain 2.6 to 2.8 per cent carbon. The more brightly glistening flakes or crystals in a fracture, the higher the carbon content. The accompanying tables give the characteristic composition of irons melted by different processes. Fig. 22 shows the microstructure of cupola iron in which there is a large amount of bright cementite chiefly in the form of ledeburite, as a result of the high carbon content. In Fig. 23 to 25 the amount of cementite becomes less with decreasing carbon contents. Compare these with Fig. 8 which shows the microstructure of a piece of cupola iron which was not changed by the annealing process, and in the hard core which resulted contained the original 3.50 per cent carbon.

When one considers that cupola iron, in addition to its high cementite content, always contains a large amount of sulphur which retards the annealing process, one finds the reason for the well-known fact that cupola iron requires a higher temperature and longer annealing than air-furnace iron, since in the latter there is a smaller amount of cementite to be broken up or removed by decarbonization than in the former. The low carbon content of air-furnace iron is especially favorable to ordinary practice because then the silicon content can be quite high without fear of the formation of primary graphite. Air-furnace iron, to be poured into a section approximately ½ x 1½ inch, may have a silicon content of 1 per cent without causing any noticeable primary graphitization, if the carbon is not much in excess of 2.6 per cent.

If, in the case of electric-furnace iron, the carbon content is allowed to go much below 2.35 per cent, castings are liable to show small blow holes. Furthermore, this iron would have such a high shrinkage that, in spite of high silicon, the gates and risers would have to be so large that production would be decreased and the technical difficulties would outweigh the advantage of a short annealing.

Thin castings usually run poorly from low-carbon iron, while a short thick casting is liable to show cold shuts. These are places which are formed when the stream of iron has been broken by a core or when two streams of iron flow together, the thin oxide skin which forms in the mold preventing union of the two streams of iron because of its rapid solidification.

Institute of Metals Head Suggests Aims

At the annual meeting of the British Institute of Metals, which was held in London, March 8 and 9, it was announced that the membership roll now carries 1410 names, this being the largest in the history of the institution. The increase in the past year was 112. Nine papers were read and discussed at the annual meeting, including three of foundry interest, namely, "Some

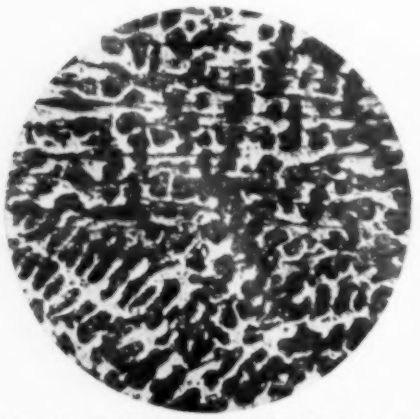
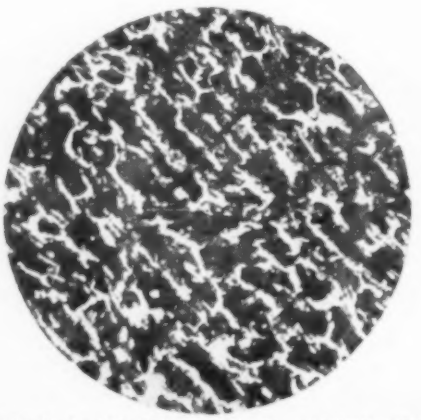
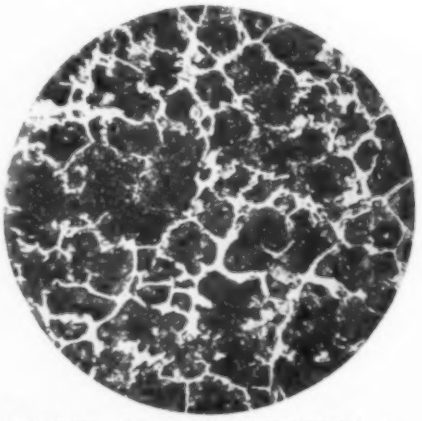




FIG. 23—WHITE IRON MELTED IN A CRUCIBLE—X 100 DIA. FIG. 24—WHITE IRON MELTED IN A REVERBERATORY FURNACE—X 100 DIA. FIG. 25—WHITE IRON MELTED IN AN ELECTRIC FURNACE—X 100 DIA.

Cases of Failure in Aluminum Alloys," by Dr. W. Rosenhain, National Physical Laboratory, London; "The Effect of Impurities on Recrystallization and Grain Growth," by the Research staff of the British General Electric Co., London; and "A Further Study of the Alloys of Aluminum and Zinc," by Dr. D. Hansen and Marie L. V. Gayler, National Physical Laboratory, London.

The new president of the institution, Leonard Sumner, Broughton Copper Works, Manchester, was inducted into office at the opening session, March 8. In his presidential address he discussed the question of specifications thoroughly and pointed out the valuable services which engineering organizations might perform by standardizing specifications and avoiding difficulties with unsuitable specifications. Commenting on the growing tendency to market alloys by analysis rather than by brand, Mr. Sumner made the following statement:

"I am bold enough to assert that the time is coming when no 'Jones' Metal' or 'Smith's Bronze' will be accepted by the user unless the manufacturer is prepared to lay his cards on the table and say at once what his alloy consists of. The alloy may be called any name one likes, but its constituents should be stated, and the maker should be prepared to stand by or fall with the metal he puts on the market."

Drawing Alterations Should Be Distinct

BY M. E. DUGGAN

THE manner in which proposed changes are indicated on an existing drawing does not receive the attention it deserves in some drafting rooms. It is something that causes considerable trouble in the pattern shop and occasionally the mistake is not discovered until the casting has been made and the machine work is under way. It is just as easy for the draftsman to change the drawing so that it will be clear and intelligible to the patternmaker as it is to make it in a way that is impossible to understand. The two sketches shown in the accompanying illustration will help in making my meaning clearer.

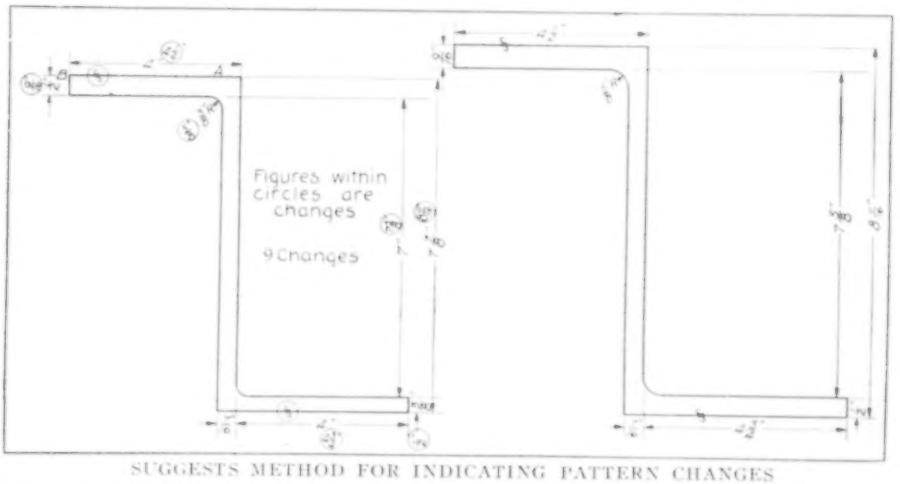
Some time ago I was handed a blue print showing nine different parts of a certain machine. One of these parts is shown on the original drawing at the left in the accompanying illustration. Nine patterns were made corresponding to this blue print. Later it was decided to alter the general design of the machine and this alteration affected every one of these nine patterns.

A complete set of new drawings was made with alterations on them *but not shown*. This probably sounds peculiar.

Nine patterns had been made from the original drawing. The new drawing called for 27 changes to be made on those patterns. If it had been a case of making an entire set of new patterns the new drawing would have been perfectly satisfactory; but in this case it became necessary to check the old drawing and the patterns against the new drawing to find out wherein lay the proposed changes.

The new blue print contained about 175 dimension lines and figures. There was not a line or mark of any kind to indicate where a change had been made from the original drawing. Just imagine what it means to be handed a blue print calling for 27 changes to be made in an existing set of patterns to conform to a new and altered drawing. Where would you commence and how would you know when you had finished making all the changes?

Would it not be better instead of making a second drawing as shown at the right carrying all the new dimensions, to change the original drawing? The altered dimensions could be shown surrounded, for example, by a circle or other distinctive mark as shown at *A*, *B* and *C* at the left. At *A* 4 inches was the original size, the altered size 4½ inches is shown in the circle. At *B* the face of the casting was left rough



SUGGESTS METHOD FOR INDICATING PATTERN CHANGES

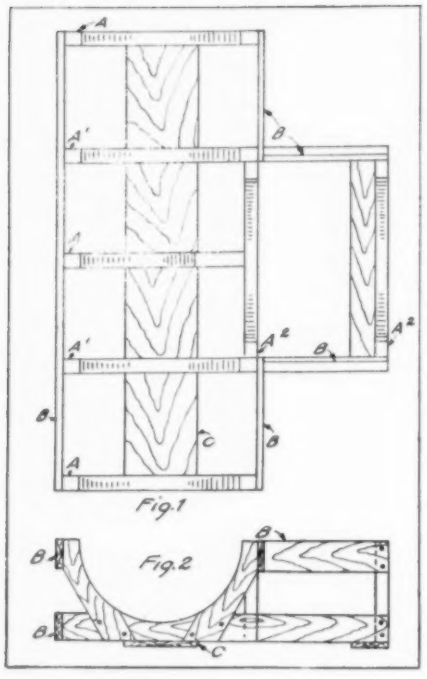
in the altered design this face is finished as indicated by the symbol (*f*) also inclosed in a circle. The total number of changes to be made, nine, is indicated at *C*.

The circles indicate where changes are to be made. They are quite apparent and stand out distinctively from the remainder of the drawing. The patternmaker can note them readily and check them off as he proceeds with the work. When he has checked the last one he knows the job is done. This method eliminates guess work and mistakes.

Method Employed To Make Tee Corebox

BY J. W. BROADBENT

A PATTERN or corebox for a standard job usually is made in a solid substantial manner to withstand the ravages of time and ill usage. Where only one, or at the most, a limited number of castings are required, a more or less temporary pattern or corebox may be prepared at a considerable saving in pattern shop expense. However, occasionally a customer appears who seems to think that a patternmaker possesses supernatural powers. He expects a wooden pattern or corebox that will not warp, twist, shrink, or even break, and he wants it for a price that hardly would cover the cost of the flimsiest construction. The corebox shown in the accompanying illustrations shows the type of construction selected recently



FIGS. 1 AND 2—PLAN AND END ELEVATION OF COREBOX FOR STANDARD TEE PIPE CONNECTION

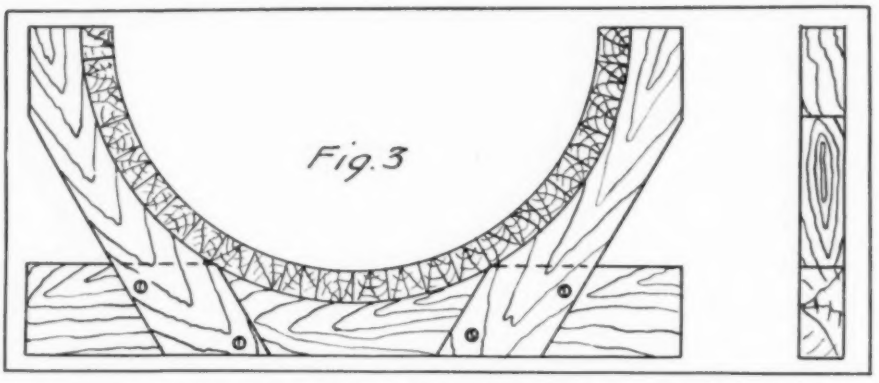


FIG. 3—THE LAGGING WAS MADE IN NARROW STRIPS SO THAT THE SURFACE WOULD CONFORM CLOSELY TO THE CIRCLE THIS ARRANGEMENT MINIMIZED THE AMOUNT OF HAND FINISHING REQUIRED

for a set of standard *T* coreboxes ranging in size from 12 to 24 inches. It is rigid, strong and durable and is made easily.

The plan is shown in Fig. 1, and the end elevation of the frame before the lagging was nailed in place is shown in Fig. 2. The supports *A* were built up of three pieces cross halved together, thus making a stronger job than where cut out of the solid lumber. This method of construction also reduces the tendency to warp. The bottom pieces of *A*1 were carried through to the end of the branch outlet and were glued and screwed to the supports, *A*2. The braces *B* greatly helped to stiffen the frame and held it square and rigid while the lagging was being nailed in place. The supports were adjusted by a center line on the board *C* and screwed in place.

An end view with the lagging in place is shown in Fig. 3. The narrow staves, 1 inch in thickness, were beveled on the saw. They were made narrow so that the flat surfaces would conform closely to the circle, and after they were glued and nailed to the supports required little finishing with a round bottom plane and rough sand paper. After the heads were screwed on each outlet the inside was given several coats of shellac and the outside a coat of paint.

Emulate American Malleable Practice

THE first annual banquet of the Malleable Ironfounders' association held at the Grand hotel, Birmingham, Feb. 23, was made memorable by two presentations, one to W. H. Proctor, president, one of the directors of the Wycliffe Foundry, Ltd., Lutterworth, Leicester, and the other to F. J. Cook, secretary, the moving spirit of Rudge Littley, Ltd., West Bromwich. Mr. Cook has attained an international reputation and it is understood will present a paper this year before the convention of the American Foundrymen's association to be held in Rochester, N. Y., June 5-9. The attendance included as guests the Lord Mayor of Birmingham, Alderman David Davis and J. P. Hannon, M. P. for the Moseley division of Birmingham.

Charles Retallack, 72 years of age, a veteran iron founder connected with John Harper & Co., Ltd., Willenhall (Staffs), declared he never had known a time when there was so much thought, anxiety and research put into the industry. The malleable ironfounders of Great Britain would not rest either in regard to research, improvement of processes, or mechanical exactitudes, until their product equaled in every way that in the United States. Some makers have attained a high level of quality, but the spirit of the association will be satisfied with nothing but the best.

While they have pushed ahead to some extent, he said, they cannot fail to admire the marvelous progress made in America. He had just returned from his fourth visit, which included inspection of 17 plants. He was astonished to note the vast resources of the Northern Malleable Co., of Minneapolis, where 10 chemists tabulated the returns every day with the greatest precision. He returned to England determined to insist on the same kind of thing at home. Sometimes he succeeded and at other times he did not because many of the American methods were not applicable to Great Britain. However, the malleable industry was not in a decline. By putting their brains into the industry, their chemists to work and by getting their young men into the laboratories they can establish records equal to any.

He never has been afraid to introduce a stranger into his works, because invariably he gained more than he gave in any interview and always could learn something. The late Joseph Tangye, one of the Quaker founders of the Cornwall works at Smethwick once said to him: "Charles, never be afraid to tell a man everthing thou knoweth. It is not much, after all, is it?"

He also favors frequent meetings between employers and employed to talk over processes, improvements, difficulties and successes. The Cast Iron Research association has brought knowledge and intelligence beyond parallel or calculation to bear on the business.

W. Edgar Hale, Thomas L. Hale, Tipton, Ltd., presented W. H. Proctor with a silver revolving tureen and F. J. Cook with a pair of silver entree dishes, at the same time acknowledging in glowing terms the value of their services to the association. In accepting the gifts, Mr. Cook remarked that they have set out with high ideals to extend their business, improve the quality of their product and increase their remuneration. It is deplorable, he said, that they can get a higher price for a gray iron casting than for a similar article in malleable iron. Having to meet domestic, continental and American competition they will fail unless they can combine to secure such a return as will enable them to pro-

duce castings of a proper quality. Mr. Proctor also emphasized the necessity for organization on the ground that theirs is one of the most hazardous of industries, entailing possibly a greater risk to the manufacturer than any other. Their workmen possess the highest intelligence, skill and character, but neither managers or workmen are properly remunerated and the greater number of firms engaged in the malleable industry are losing money. If they can overcome existing jealousies and get together they can not only improve, but cheapen the product and help themselves in such matters as railway rates, fuel prices and foreign competition. He has every confidence that eventually their business will be placed on a sound basis and their product measure up to the highest standards.

Convention Plans Rapidly Take Form

QUICK co-operation on the part of the Rochester manufacturers and business men, working with the officers of the American Foundrymen's association, has resulted in pushing forward preparations for a convention and exhibition which promises to be one of the largest held in the history of the association. Following quickly on the selection of an executive committee, late last month, a complete local organization has been built, functioning along lines which have made Rochester known throughout the country for its progressive and up-to-date business accomplishments.

As stated previously, the executive committee, made up of the chairmen of the various divisions headed by Norman Van Voorhis, Galusha Stove Co. as general chairman and P. B. Van Deusen, secretary of the Rochester Chamber of Commerce as secretary, has been expanded and various working committees organized with the following personnel:

ENTERTAINMENT COMMITTEE: H. G. Hetzler, chairman, North West Foundries Co., Inc.; David Baxter, Monroe Ave., Brighton Station; A. N. Prayer, Co-operative Foundry Co.; C. E. Hoyt, secretary, American Foundrymen's association; W. B. Robinson, *Iron Age*, Pittsburgh, Pa.; W. W. Sanderson, Carborundum Co., Niagara Falls, N. Y.; E. A. Scheibe, Bausch & Lomb Optical Co.; William J. Wark, E. J. Woodison & Co., Buffalo, N. Y.; Delos H. Wray, National Brass Mfg. Co.

BANQUET COMMITTEE: W. R. Bean, president, American Foundrymen's association; Alfred E. Howell and J. P. Pero, past presidents, American Foundrymen's association; G. B. Pettingill, T. H. Symington Co.; Louis P. Willsea, Willsea Works.

GOLF COMMITTEE: Matthew Elliott, chairman, Erie Foundry Co.; Donald S. Barrows, T. H. Symington Co.; William S. Riley, W. S. Riley Co.; J. F. Weller, Kellogg Mfg. Co.

HOTEL COMMITTEE: A. H. Jones, chairman, American Woodworking Machinery Co.; A. R. McHenry, T. H. Symington Co.; A. J. Messner, Powers hotel.

PUBLICITY COMMITTEE: Edgar F. Edwards, chairman, Rochester Industrial Exposition association; George Ely, American Woodworking Machinery Co.; H. G. Stellwagen, North West Foundries, Inc.

RECEPTION AND INFORMATION COMMITTEE: Louis P. Willsea, chairman Willsea Works; Arthur Batzold, National Car Wheel Co.; Matthew Elliott, Erie Foundry Co.; J. W. Fulreader, James Cunningham, Son & Co.; James E. Gleason, Gleason Works; C. W. Griswold, S. B. Roby Co.; Fratz Haverstick, Haverstick & Co.; David R. Henry, Flower City Foundry Co.; Charles P. Hery, Ingersoll, Erskine & Healy; A. C. Kehr, Foster-Armstrong Co.; V. C. Kreuter, American Laundry Machine Co.; James McHenry, Gleason Works; S. E. Miller, Sargent & Greenleaf, Inc.; S. W. Miller, Rochester Welding Works; Charles S. Owen, Chapin-Owen Co.; Theodore Pickering, Josiah Anstice & Co.; Robert L. Poole, General Railway Signal Co.; T. A. Soults Still Stove Works; Mayor Clarence D. Van Zandt, City Hall.

FINANCE COMMITTEE: Schuyler H. Earl, chairman, Gleason Works; Matthew Elliott, Erie Foundry Co.; Norman Van Voorhis, Galusha Stove Works.

Exceptional facilities are offered for the exhibition features of the convention. Exposition Park, Rochester, is located only a short distance from the center of the city. Three car lines provide ready access, and the buildings will provide over 50,000 feet of exhibit space in addition to a convention hall, where the various technical meetings are to be held. A dining room, on the grounds, is another feature which will be invaluable in gathering together all of the activities of the meeting.

Reduced fare has been obtained through all of the passenger associations of the United States and this arrangement will be extended to include special rates from Canada. Under this plan round trip tickets will be sold at one and one-half fare. Tickets will be sold to association members and dependent members of their families, and will be given via the same route only, in both directions. They will be sold from June 1 to 7, and will be validated at Rochester by the agents at the regular ticket offices of the lines over which they read into Rochester, and must be used returning to reach the original starting point not later than midnight of June 16th.

Under the identification plan it is necessary for the association making application for reduced fare to issue certificates duly signed by some officer of the association. Reduced fare tickets will be sold only to those who have these certificates.

Large Foundries Merge in Pittsburgh

The Union Steel Casting Co., Pittsburgh has purchased a large block of capital stock in the Pittsburgh Rolls Corp. of the same city. The plants are both located in the Lawrenceville district, and it is the intention of the Union Steel Casting Co. in making this purchase that the two companies shall work in close harmony, and that no changes be made in the local organization or management of the Pittsburgh Rolls Corp., other than certain directors who will be retired by reason of the purchase will be replaced by officers of the Union Steel Casting Co.

The Pittsburgh Rolls Corp. (Phoenix Roll works) has operated in the same locality for over 50 years. The present officers are D. L. Eynon, president; Q. S. Snyder, vice president and treasurer; P. M. Fleming, secretary.

The Union Steel Casting Co. was organized in 1899, and has grown from a small beginning to be a leading steel foundry. The officers are C. C. Smith, chairman; J. P. Allen, president; J. B. Henry, vice president and general superintendent; S. H. Church, vice president; G. W. Eisenbeis, treasurer; W. C. Eichenlaub, secretary.

Remove Equipment Plant

The York, Pa. plant of the American Foundry Equipment Co., 366 Madison avenue, New York, has been removed to more commodious quarters in East Market street, York. This plant manufactures the company's molding machines, flasks, jackets and pattern mounting sundries. The sand cutting machinery, sand blast equipment and core machines will continue to be manufactured at the Chicago plant.

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Rochester Convention Opportunities

HAD the convention and exhibition of the American Foundrymen's association been held in the regular course last fall, doubt exists whether those who comprise the moving force in the castings industry could have pulled themselves from the depths of despond long enough to attend and take part. Initiative and interest lag when business depression looms. This spring has brought a brighter outlook. With steady progress, manufacturing operations are improving and a quickening demand for castings is sending pulsations of cheer into foundries throughout the country. Early indications give promise of the effect of this improvement upon the attendance and interest in the June meeting of the American Foundrymen's association. Competitive conditions which have arisen, render imperative a knowledge of the latest developments in foundry equipment, management and operation and no better opportunity to acquire technical knowledge is offered than that presented by the convention to be held in Rochester. An exceptional list of papers on practical subjects will be presented and discussed, and in addition every foundryman will welcome the chance to exchange views with the leaders of his industry. Particular attention will be given to subjects of vital interest to shop foremen and superintendents, and many of the larger establishments, quick to see the value of the opportunity, already are arranging to send their foundry executive staffs. Under competitive conditions the need is even greater for the small foundryman, and doubtless his perception of his own problems will lead him to Rochester in June.

Iron Output Tumbles in 1920

PIG iron production figures for 1921 recently issued by the American Iron and Steel Institute, mark the period just past as one of the darkest in the fifteen years recorded. The comparison is unusually dismal through the proximity of 1920, which will be remembered as one of the most remarkable periods ever experienced, especially in the manufacture of the foundry grades. From the high total of 5,957,782 tons of foundry iron and ferrosilicon produced in 1920, the drop to 2,568,136 tons in 1921 represents a decrease of 56.89 per cent. The malleable grades showed an even greater decline. The 1920 total production was 1,310,951 tons and that recorded for 1921 was 457,340 tons, giving a loss of 853,611 tons or 65.11 per cent. Probably these figures do not constitute a true measure of the tremendous drop in foundry activity, as doubtless the end of 1920 saw large stocks, which were used last year.

The total production of pig iron for 1921 was 16,688,126 tons which when compared with the 1920 output of 36,925,987 tons shows a decrease of 54.81 per cent. Both the basic and bessemer grades closely approach the average of the total production in percentage loss, the former showing a decrease of 53.68 per cent and the latter, 53.61 per cent. The total output of basic iron maintained its lead over the bessemer grades, the former showing a total of 7,753,071 tons and the latter, 5,595,215 tons.

Attention recently has been given to the relative merits of sand cast and machine cast pig iron. In 1921, 998,898 tons were sand cast and 5,931,586 tons machine and chill cast, the remainder being either used in the molten state or used direct in castings.

Trade Outlook in the Foundry Industry

PRACTICALLY without an exception, the trends indicated the first part of the month have carried through. Improvement in foundry operation throughout the country has constituted no exception. While the advance has not been so strong as to hold out false hopes of an early resumption of capacity production, the character of the orders reaching practically all classes of castings plants indicates a healthy condition. Perhaps the most encouraging feature of the situation is the coincident improvement in general business and in industrial and commercial lines which contribute most directly to the foundry industry.

Building Expands

The building industry in the United States is ranked second only to agriculture in point of importance and in the number of persons directly and indirectly engaged. Despite the continued high freight rates which have constituted an added burden on building costs in many sections, the spring undertakings have grown consistently. Residence construction leads, as might be expected from the pressure exerted during the period just past and also from the neglect of this phase of construction during the war. Schools, public buildings, commercial structures and those devoted to the various phases of public convenience follow; and industrial construction is last on the list. As a result the demand for heating equipment, sanitary ware, plumbing sundries, building hardware and the various types of domestic machinery, including laundry equipment, sweepers etc., has improved steadily and promises much for the months to come. These requirements, of course, bring a steadily increasing volume of casting orders to the foundries. Indirectly, the result is evident in public service extensions, carrying a demand for pipe and municipal castings of all descriptions, from lighting poles to sewer rings, gutter inlets and manhole covers.

Improvement Marked

One accurate means of comparison in general building construction is furnished by the structural steel awards. During the third week in March these totaled approximately 40,000 tons, as compared with the total for February of 78,700 tons, or 43½ per cent of capacity. In other words, a single week in March marked more than half as many contracts placed as the entire previous month. February, according to reports from 27 northeastern states showed an increase of $11,000,000 to a total of $177,365,000 in building contracts awarded, according to the department of commerce. Residence construction contracts remained practically on a par for the two months, but business buildings gave the increase noted. Automobile production is holding to its steady pace, giving a total output of passenger cars and trucks for February of 129,500 as compared with 90,486 for January and 78,995 in December. Reflected in the castings industry this has resulted in improved operation in gray iron and malleable shops specializing in automobile parts.

Rail Buying Laggard

Although freight car orders showed an increase in February, the improvement has not carried through in a proportionate degree into March. The orders for February approximated 14,520 cars, as compared with about 11,000 cars for January. During February, inquiries appeared for about 5000 cars. Locomotive buying was in proportion to these figures. However, the volume of railway orders has not been sufficient to bring many of the larger foundries specializing in this work to capacity production. Western gray-iron, steel and malleable shops specializing in railway work seem to be slightly more fortunate than those in the East in this particular. The idle car figures continue to register the increasing need for railway equipment; but in the absence of a tense demand for fuel shipments incident to the impending coal strike, the need has not been so acute. Foundries, in general, have faced the threatened coal strike with apathy. The demand has not been sufficient to bring about any marked rise in prices and few have endeavored to rush shipments to meet their needs. The situation probably is due to a feeling that the strike will bring lower coal prices, so why stock heavily on coke, which might in the next few months have to be written off as a loss against future contracts. Malleable foundries throughout the country are operating on improved schedules, some estimating the average rate at between 35 and 40 per cent of normal. Jobbing foundries are slightly more active than during the winter. In the New England districts the demand from the textile industry, from manufacturers of small tools and from the diversified industries, has brought a steady volume of orders to both jobbing and specialty shops. Through the western states, stove foundries are experiencing an exceptional spring trade. Some stove works in Detroit, closed during a portion of 1921, are operating day and night shifts.

Prices of Raw Material for Foundry Use

CORRECTED TO MARCH 23

Iron		Scrap	
No. 2 Foundry, Valley	$19.00	Heavy melting steel, Valley	$14.25 to 14.75
No. 2 Southern, Birmingham	15.00 to 15.50	Heavy melting steel, Pitts.	15.00 to 15.50
No. 2 Foundry, Chicago	20.00	Heavy melting steel, Chicago	12.50 to 12.75
No. 2 Foundry, Philadelphia	20.84 to 21.26	Stove plate, Chicago	14.50 to 15.00
No. 2 Foundry, Buffalo	18.00 to 18.50	No. 1 cast, Chicago	15.25 to 15.75
Basic, valley	18.00	No. 1 cast, Philadelphia	17.25 to 17.75
Basic, Buffalo	18.50	No. 1 cast, Birmingham	14.00 to 15.00
Malleable, Chicago	20.00	No. 1 cast, Buffalo	16.25 to 16.50
Malleable, Buffalo	18.25	Car wheels, iron, Pittsburgh	16.00 to 16.50
Coke		Car wheels, iron, Chicago	16.50 to 17.00
Connellsville foundry, coke	$4.25 to 4.75	Railroad malleable, Chicago	14.25 to 14.50
Wise county foundry, coke	5.50 to 5.75	Agricultural mal., Chicago	14.25 to 14.50
		Railroad malleable, Buffalo	13.00 to 14.00

Brass Shops Accelerate

With the improved demand from constructional lines, railroads and automobile plants, brass foundry conditions are brighter than at any time for several months. Prices for nonferrous metals, based on New York quotations in the *Daily Metal Trade* of March 23, follow: Casting copper, 12.62½c; electrolytic copper, 12.87½c; Straits tin, 29.37½c to 29.50c; antimony, 4.25c; lead, 4.70c to 4.75c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c, and open market, 14.00c to 15.00c. Zinc is 4.70c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

OLIVER STUBBS, president of the Institution of British Foundrymen, who with Thomas H. Firth, past president of that association, will sail for the United States early in April, is one of the foremost foundrymen of Britain. He is joint managing director of Joseph Stubbs, Ltd., Manchester, manufacturer of textile machinery and castings. In addition to his position as president of the society mentioned, he is president of the National Ironfounders Employers' federation, an official of the Engineering and National Employers' federation and a member of the council of the British Cast Iron Research association. Aside from his activity in the technical and commercial branches of the foundry industry, Mr. Stubbs is a prominent member of the Institution of Mechanical Engineers and other organizations of a scientific and business nature. Thomas H. Firth who will accompany Mr. Stubbs, is managing director of the Brightside Foundry & Engineering Co., Sheffield, which specializes in ingot molds, rolls and steel mill equipment. This company has produced some of the largest gray-iron castings ever made in England. Mr. Firth was president of the Institution of British Foundrymen in 1918 and has been active in that and other technical societies.

The visit of these two gentlemen to the United States is an outgrowth of the tour made by A. O. Backert, president of the American Foundrymen's association, in the interests of promoting closer relationship between the technical organizations representing the castings industry in this country and abroad.

F. G. Peterson has resigned his position as foundry superintendent for the Bucyrus Co., South Milwaukee, Wis.

M. J. Gregory has been made manager of the Lakey Foundry & Machine Co., Muskegon, Mich. Mr. Gregory formerly was in charge of the General Motors Corp. foundries.

Stanley Sheldon, for the last five months manager of the Murlless Foundry, Rockville, Conn., has resigned to become a department manager in a Paterson, N. J., wholesale hardware company.

OLIVER STUBBS

THOMAS J. FIRTH

E. G. RIPPEL

Samuel Lewis Smith, vice president of the National Malleable Castings Co., Cleveland, is in Great Britain on a business trip. Mr. Smith has extended his stay but expects to return to the United States in April.

H. B. Sprecken, formerly foundry superintendent, Lakey Foundry & Machine Co., Muskegon, Mich., has been appointed foundry superintendent for the tractor works of the International Harvester Co., Chicago, Ill.

Ted Martin, who for many years was foundry superintendent for the George H. Smith Steel Casting Co., Milwaukee, and more recently was in the foundry business in the Erie district has been made manager of the Maynard Steel Co., Milwaukee.

Franklin G. Smith, president and general manager, Osborn Mfg. Co., Cleveland, will sail for New York March 25 on his return from a two months' business trip during which he visited the principal cities of the British Isles and many of the larger continental centers.

M. M. Marcus, general superintendent of the Rhode Island Malleable Iron Works, Hillsgrove, R. I., addressed the Providence Engineering society, Providence, at its meeting March 14. Mr. Marcus explained to the engineers the modern scientific practice followed in manufacturing malleable iron castings.

Leonard Sumner, chairman and managing director, Broughton Copper Co., Ltd., Manchester England, has been elected president of the British Institute of Metals. Mr. Sumner is unusually well known in the nonferrous metal industry in Great Britain. In recognition of services which he performed for the British government during the war he was decorated with the Order of the British Empire.

G. R. Brophy, metallurgist of the research laboratory of the General Electric Co., spoke on "Calite—A New Heat Resisting Alloy" before the Hartford, Conn., Section of the American Society for Steel Treating, March 9.

William F. Cutler, vice president of the American Brake Shoe & Foundry

Co. has been elected a member of the board of the New York Trust Co. to succeed his father, the late Otis H. Cutler.

E. E. Allyne, director of the Aluminum Manufacturers Inc. and the Cleveland Tractor Co., Cleveland recently was injured in an automobile accident near Palm Beach, Fla. Mr. Allyne was returning from Cuba, the first portion of the journey having been made by airplane and while in an automobile on the trip from the landing field to Palm Beach the machine skidded and was wrecked. Mr. Allyne suffered a broken leg and other injuries.

W. M. Corse, general manager, Monel Products Corp., Bayonne, N. J., has tendered his resignation to assume charge of the division of research extension for the National Research council, Washington. Mr. Corse expects to assume his new duties about April 1. For many years Mr. Corse has been active in technical society work and this new position affords him an unusual opportunity, because of his wide acquaintance, to further the work of the council. A limited part of Mr. Corse's time will be devoted to personal consulting work.

E. G. Ripple, sales manager for the Buffalo Foundry & Machine Co., Buffalo, has withdrawn from that organization and temporarily will retire from business activity. Mr. Ripple entered the foundry business with Hopkins, Ripple & Co. when he was only 18 years of age. This firm later became Ripple & King and the Ripple Mfg. Co., successively. He was impressed with the possibilities of applied chemistry in the foundry industry and his work secured recognition for him and a position with the Ball Engine Co., Erie, Pa. In 1901 Mr. Ripple removed to Buffalo and was instrumental in organizing the Buffalo Foundry Co., later the Buffalo Foundry & Machine Co. with which firm he has been connected continuously until the present time. Through Mr. Ripple's influence this company concentrated on chemical apparatus and the various types of machinery demanded in the various lines of chemical manufacture and became one of the largest establishments in the world, devoted to this work. Mr. Ripple has been succeeded as sales manager by C. W. Pearson, assistant treasurer.

Chicago Foundrymen Hear Sand Discussion

At the March meeting of the Chicago Foundrymen's club, Eugene W. Smith, superintendent of foundries for the Crane Co., Chicago, read a paper on molding sand and presented a tabulation of the characteristics and analyses of sand which proved of great interest. R. A. Bull and R. W. Kennedy, chairman and secretary, respectively of the joint committee on molding sand appointed by the American Foundrymen's association and the National Research council, discussed the work of that committee in seeking a basis for standards from which the foundrymen may work. C. S. McNeal and H. S. Vrooman spoke from the standpoint of the sand producer and urged that a co-operation of interest would result in furnishing the proper grade of sand needed for each class of work.

Addresses Club on Blast Meters for Cupolas

Louis L. Vayda of the Bacharach Industrial Instrument Co., Pittsburgh, described a blast meter for the benefit of the members of the Pittsburgh Foundrymen's association, at its regular monthly meeting which was held at the General Forbes hotel March 21. This instrument which measures the amount of air to be used in the cupola blast was illustrated by a dozen or more large crayon drawings and described in detail by the speaker. Arrangements are being made for the attendance of a large number of Pittsburgh district foundrymen at the annual meeting of the American Foundrymen's association to be held at Rochester, N. Y., June 5-9. President F. H. Clay of the local body presided at this dinner and meeting. Representing the Purchasing Agents' association, G. Walter Sanborn of the United Engineering & Foundry Co., presented a standardized form of pig iron contract for the approval of the members. This matter was referred to a committee for investigation and report at the April meeting.

Tentative Program for Foundry Convention

A program made up of more than twenty papers has been made up by the papers committee for presentation at the Rochester convention of the American Foundrymen's association. To assist those who desire to attend only during the days devoted to their own special branches of the foundry industry, a tentative plan has been prepared which is given in outline as follows:

Monday—a. m., opening of exhibition, p. m., joint general session—American Foundrymen's association, and Institute of Metals division, A. I. M. E. Address of welcome, Response, etc.

Tuesday—a. m., Gray iron session; p. m., Steel and nonferrous sessions.

Wednesday—a. m., Steel and nonferrous sessions; p. m., Industrial Relations session; Evening annual banquet.

Thursday—a. m., General session—Molding sand symposium; p. m., Special entertainment features.

Friday—a. m., Malleable sessions; Final business session American Foundrymen's association; 5 p. m., Close of exhibition.

Birmingham Convention Dates Set Ahead

The annual convention of the Institution of British Foundrymen for reading and discussing papers will take place in Birmingham, England, June 21 to 23, during the International Foundry Trade exhibition which will open June 15 and close June 24. The exhibition is being conducted jointly under the auspices of the Institution of British Foundrymen and the British Cast Iron Research association, the business management of the exhibition being in charge of the Birmingham chamber of commerce.

A Correction

Through a typographical error, the article "Core Wires Bent in Plain Wooden Dies" on page 164 of the Feb. 15 issue was credited to John Brenner, instead of John Grennan, who is connected with the University of Michigan, Ann Arbor, Mich.

Obituary

Edward Schroeder, foundry foreman, American Car & Foundry Co., Chicago, died March 6 at his home in that city. Mr. Schroeder had been in the employ of the American Car & Foundry Co. for 30 years.

George Wedlake, president and general manager of the Cockshutt Plow Co., Brantford, Ont., died March 3. He was 63 years old. He began life as a molder and rose steadily to the position he occupied at his death. His death was brought about by overwork in connection with his duties as mayor of Brantford. He had long been interested in civic and municipal affairs.

Senator John Milne, president of the Burrows, Stewart & Milne Co., Ltd., Hamilton, Ont., stove founder and scale maker, died March 4 in his eighty-fifth year. He was born in Aberdeen, Scotland, and went to Canada in 1854. He was one of the founders of the Steel Co. of Canada and was connected with other business enterprises.

Foundry Equipment Needs Increase

Pickup in Contributing Lines Brings More Active Inquiry for All Classes of Foundry Machinery and Supplies—Ford Interests Heavy Buyer in the West

WITH February marking a minor peak in the advance toward normal business in foundry equipment lines, confidence prevails that better conditions are at hand. True, March has seen a slackening in some lines, particularly in the demand for repair and replacement parts for foundry machinery; but inquiry for new installations has improved steadily. One Ohio manufacturer of sand conditioning and handling equipment states that an average of one inquiry every three days is received. This, contrasted with the absence of all interest during the close of 1921, and considering the class of equipment handled constitutes a most favorable sign. Sales of ladles, flasks, trucks, barrows and other sundries have increased steadily, throughout the month and some purchases, notably of flasks, have indicated the trend toward completely equipping foundries for the most economical production. Molding machine inquiries are active, but many orders are held pending proof that the present pickup in foundry operation is substantial and will endure. The Ford Motor Co., Detroit, is a heavy purchaser of tumbling barrels, molding machines and is stated to be purchasing on an ultimate requirement of 24 new cupolas. The Westinghouse Electric & Mfg. Co., Cleveland has purchased two sand blast rooms from the Pangborn Corp., Hagerstown, Md. and will also install four new tumbling barrels supplied by the Whiting Corp., Harvey, Ill. The Sterling Brass Co., Cleveland, is constructing a new brass foundry for the manufacture of plumbers brass goods and has not yet purchased equipment. Allen Sogg, Hippodrome building, Cleveland is architect. Oil-fired core ovens and brass melting units will be installed. The company also will require cleaning room and plating equipment. Sidney Weil is president and treasurer of the Sterling Brass Co.

Orders Multiply in Pittsburgh District

PITTSBURGH district foundries are increasing their operating schedules somewhat, roll foundries having attained an average operation of about 50 per cent in the past week or so with other foundries showing like increases. This is typified not alone in pig iron and coke purchases but in equipment installations as well. While large buying for the most part still is withheld, occasional orders are noted and small supplies show more life than has been true for some time past. One local foundry is about to close on sand blast and tumbling barrel equipment; the Westinghouse Electric & Mfg. Co. is understood to have booked considerable sand blast equipment with the Pangborn Corp.; and a nearby interest is purchasing a large used sand blast outfit. Recent orders include an electric sand sifter; flasks for the General Motors Corp. for castings for its new air-cooled automobile engine; $10,000 worth of flasks to an Ohio manufacturer for bathtubs from one of the sanitary ware producers; and a fairly large number of molding machines including some of the largest rollover type machines produced by the Herman Pneumatic Machine Co., Pittsburgh. Orders for the latter type of equipment placed recently call for four rollover machines, two cope and two drag for the American Radiator Co., Buffalo, one each cope and drag for the Commonwealth Steel Co., Granite City, Ill., taking a 12 or 13-foot flask for large bolster castings; one for the Flockhart Foundry Co., Newark, N. J., and one for the Whiting-Adams Corp., Boston. Inquiries for foundry equipment of all sorts are plentiful covering everything from molding machines to core ovens, cupolas and cranes. One or two inquiries for cupolas are noted locally while three or four come from Ohio and eastern Pennsylvania territories. A few large core oven installations may reach the closing stage shortly, one of which will represent an outlay of about $10,000. A local iron and brass foundry is in the market for an overhead trolley system complete with pouring devices, etc. While no recent inquiries are noted for electric furnaces from merchant foundries, a few have been ordered by automobile producers which operate their own foundry departments. Considerable electric furnace buying is expected to develop in this territory within the next two months. Included in the 22 cranes ordered recently by the Wheeling Steel Corp from the Morgan Engineering Co., Alliance, O., are two 125-ton ladle cranes for the Steubenville, O. plant. So far as can be learned the Enterprise Foundry Co., Pittsburgh, has not taken steps to replace equipment badly damaged in a recent fire, but probably will do so within the next few weeks.

Demand Light in Eastern Market

WHILE a fair number of scattered orders are being placed in the eastern foundry equipment market, sellers assert that the business in March was of less volume than in February, despite the fact that the latter was a shorter month. It appears that in some lines, such as pipe and sanitary ware, the foundries are quite active, but in others, the foundries are as quiet as they were earlier in the year, and that all in all, there is little additional incentive to buy equipment. There is some hope that as a result of the ending of the recent molders strike in Brooklyn, there will be more interest shown in equipment by the plants in that city. Among recent buyers is the Flockhart Foundry Co., Newark, N. J. This concern has closed on a 5-ton electric overhead crane to the Pawling & Harnischfeger Co., Milwaukee, and also has purchased a sand cutting machine. Some other items of equipment are being considered. The Fischer-Sweeney Bronze Co., Hoboken, N. J., whose plant recently was damaged by fire, is looking for temporary quarters, it not being definitely decided whether to build a new plant or to buy one outright. Some replacements will be necessary before it again can take up production. The Danville Iron & Steel Co., Danville, Pa. is said to be contemplating the erection of a new foundry addition this Spring.

Western Inquiry Improves

EVERY branch of industry depending on foundry activity seems to have taken a forward step in the past fortnight. Engineers specializing in construction and replanning of foundries find projects which had been sidetracked some time ago are being taken up anew, both in

the construction of new plants and extensions to existing foundries. Inquiry for equipment and supplies is increasing steadily and is of a nature which gives greater promise than that received during the past few weeks. Construction is proceeding on the new foundry at Cadillac, Mich., and signs are that it will be operated by midyear. Pawling & Harnischfeger, Milwaukee, are increasing the size of their grey iron foundry and are planning to install an electric furnace to make their own steel castings. The most important buying in this market recently has been done by the Ford Motor Co., and represents a large total. This interest has bought from the Whiting Corp. thirty-six 30 x 40-inch tumbling barrels and nine 50-inch cupolas. From Henry E. Pridmore it has purchased nine power rockover molding machines of 24 and 26-inch capacity. The Whiting Corp. has also booked two 40-ton cranes for the Stearns-Rogers Co., Denver, Colo. A number of hand power cranes have also been taken by this interest. Foundry equipment in general is being taken at a better rate, hand ladles and geared ladles being in demand, while general supplies are moving in much larger volume, indicating a heavier melt. An inquiry from the Studebaker Co. for stripping plate molding machines is current.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Work is progressing on the improvements to the plant of the U. S. Radiator Co., Corry, Pa.

Plans are being prepared for additions and alterations to the shop and storehouse of the Stamford Foundry Co., Stamford, Conn.

Plans have been prepared by the Trenton Emblem Co., 120 Hamilton avenue, Trenton, N. J., for the erection of a foundry building.

Beaupre Bros., Franklin, N. H., contemplate rebuilding their foundry. Details of construction as yet have not been announced.

Capitalized at $20,000 the Kenyon Bearing Co., Hartford, Conn., recently was incorporated by Harold M. Kenyon, William McDonald and C. C. Thomson.

Part of the plant of the Thorpe Co., Courtright street, Bridgeburg, Ont., has been leased by the Acme Pattern & Machine Co., 1553 Niagara street, Buffalo.

Capitalized at $10,000 the Southern Foundry & Machine Co., Bolton, S. C., recently was incorporated by C. F. Cox, Lemuel Stansell and others.

The Danville Iron & Steel Co., Danville, Pa., is reported planning the erection of an addition to its foundry to increase the capacity of its plant which is now running full time.

Capitalized at $75,000, the Logan Foundry & Machine Co., Logan, O., recently was incorporated by F. V. Good, M. Yabrove, F. Harper, M. C. Good and W. Killingsworth.

Michaelson & Rognstad, architects, 3815 West Congress street, Chicago, are preparing plans for the erection of a foundry and machine shop. The name of the owner is being withheld for the present.

Contract has been awarded by Jewett & Co., stove works, Military road, Buffalo, to the Hydro Construction Co., Buffalo, for the erection of a 2-story plant addition, 75 x 95 feet.

The Pease Foundry Co., 118 King street east, Toronto, Ont., plans to rebuild its plant at Brampton, Ont., which was recently damaged by fire, and will probably enter the market for equipment.

Capitalized at $25,000 the Apollo Foundry Co., Brooklyn, N. Y., recently was incorporated by I. and D. Leezenboum. The company is represented by I. W. Eckstein, 61 Park Row, New York.

Paul Riesen's Sons Co., 1018 Humboldt avenue, Milwaukee, has been awarded the general contract to build a foundry, 76 x 276 feet, for the Bucyrus Co., manufacturer of steam shovels.

The Parker Street Castings Co., Cleveland, which was recently incorporated, is not a new organization; it formely operated under the name of the Imperial Castings Co. H. R. Street is general manager of the company.

The Consolidated Pattern Works, New York, recently was incorporated with a capital stock of $20,000 by E. S. and M. L. Washburn and H. Southworth. The company is represented by J. T. Crane, 2 Rector street, New York.

The board of freeholders of Newark, N. J., have commissioned architects to prepare plans for a vocational school to include a foundry and machine shop. This school is to be three stories, 36 x 184 feet, and to be built at an estimated cost of $500,000.

The plant of the Fischer-Sweeney Bronze Co., Hoboken, N. J., recently was damaged by fire. The loss was estimated at $100,000. It is understood the company is looking for temporary quarters, it not having defintely decided on rebuilding.

Work is progressing on the remodeling and improving of the former Fisk-Jencks foundry at Aurora, Ill., which was recently purchased by the Diversey Foundry Co., Chicago. It is expected the plant will be ready for operations within a few weeks.

Plans are being prepared by the Eureka Foundry Co., Gadsden, Ala., for the construction of a new foundry building to be devoted to the manufacture of iron and other metal castings. Evan Owen is president of the company.

The T. & A. Brass Foundry Co., Charleston, W. Va., which was recently incorporated, plans to operate a plant for the manufacture of roller bearing wheels for traction cars, brass, bronze and aluminum castings, etc. E. T. Thayer is president of the company.

The Kersey Pattern Works, 702 Date street, Los Angeles, manufacturer of metal and wood patterns and other foundry and machine shop equipment, is having plans prepared for the erection of a 1-story factory building, 50 x 120 feet.

The American Car & Foundry Co., Huntington, W. Va., has asked for bids on a general contract for an addition to its plant. Headquarters of the company are at 165 Broadway, New York. J. W. Ensign is district manager in Huntington.

The Canadian Aluminum & Brass Co. is opening a branch plant in Windsor, Ont., in a part of the plant of the Dominion Motor Castings Co. It is connected with the General Aluminum & Brass Co., Detroit. J. P. Carritte is president.

Recently organized, the Swartz Mfg. Co., Inc., Freeport, Ill., plans to take over and operate the plant and business of the Swartz Iron Foundry, specializing in the manufacture of pistons for automobile engines. Increased production is planned. Carl H. Swartz is president of the company.

Clayton Cooper and associates, of Elwood, Ind., are organizing a company to take over and operate the plant of the Elwood Foundry Co. The buildings and other property have been acquired from William O. Maines, trustee in bankruptcy. The new company in addition to iron castings will manufacture metal traffic signs, etc.

Electro-Castings, Ltd., Collingwood, Ont., is erecting a foundry and expects to have it ready for operation within a few weeks. W. T. Stephens, manager, is supervising the installation of a 2-ton electric furnace of his own design with a capacity of 12 heats in 24 hours. Gray iron, semisteel, etc., will be produced.

The Anchor Concrete Machinery Co., Rock Rapids, Iowa, maker of concrete brick and blockmaking machinery and parts, has acquired the plant and adjoining property of the Adrian Steel Castings Co., Adrian, Mich., which it will utilize for a new plant. The company recently was incorporated with a capital stock of $100,000.

Arrangements are reported being completed by the Richardson & Boynton Co., 260 Fifth avenue, New York, manufacturer of stoves, furnaces, etc., for the purchase of property, buildings and equipment of the W. A. Case & Son Mfg. Co., Kensington avenue, Buffalo, manufacturer of similar products. It is understood the plant will be used as a branch of the purchaser's main works at Dover, N. J.

A 2-story foundry building, 50 x 250 feet, is being erected by the Canadian Electric Castings, Ltd., on the former site of the foundry of the Canadian Electro Foundries, at Orillia, Ont., which was destroyed by fire some time ago. The new plant will specialize in steel castings, including grinding balls for the mining and concrete industries. Equipment will include two electric, 3-phase furnaces having a daily capacity of 18 tons.

The Lincoln Tractor & Implement Co. recently was chartered with a capital stock of $1,000,000 and plans to establish a plant at Urbana, O., for the manufacture of tractor plows. The company has purchased the old plant of the North American Chemical Co., which it will enlarge by the erection of a machine shop, 100 x 250 feet, and a steel and gray iron foundry. R. T. Parish is president of the company, George H. McCracken vice president, and Lawrence H. Norton secretary.

Plant and equipment of the Aetna Steel Casting Co., Lorain, O., has been taken over

by the newly organized Lorain Steel Foundry Co., which is capitalized at $250,000. This company now is engaged in making improvements to the plant and will produce steel castings for steel works, rolling mills, railroads, automotive manufacturers and machinery builders. W. W. Davidson is president, W. D. Jones vice president and secretary and C. M. Hartzell treasurer and sales manager.

The Automatic Water Pump Mfg. Co., 236 East High street, Jefferson City, Mo., which was recently organized with a capital stock of $2,000,000 to manufacture automatic pumping machinery, etc., has plans under way for the erection of seven factory buildings, including general ironworking department, foundry, machine shop, power house, etc. The plant will approximate 260,000 square feet of floor space and will cost about $150,000. Benjamin F. Schmetz is president of the company.

A large brass foundry is being constructed by the Sterling Brass Co., Cleveland, at St. Catherines street, near Ninety-third street and Union avenue, Cleveland. Allen Sogg, architect, is in charge. The new shop will have a capacity of about 1 ton a day of plumbers' brass castings. Equipment, which will be purchased the latter part of April, will include core ovens, oil-fired melting furnaces, plating apparatus and cleaning room sundries. Sydney Weil is president and treasurer of the company.

Incorporation of the Henry A. Poppert & Son Co., Milwaukee, with a capital stock of $50,000, is in the nature of a combination of two partnerships conducted for many years under a similar style, one manufacturing aluminum and brass castings, and the other doing machine shop and pattern work. The factory is at 421-425 Third street, Milwaukee, and was recently enlarged. The improvements give the foundry a 100-foot floor. Two new oil furnaces have been purchased. Special attention will be paid to aluminum castings, raw and machined, although brass castings will be made as formerly. The Poppert Co. is a pioneer in patternmaking and in the aluminum and brass casting industry in the Northwest. The original owners are the principal stockholders in the new corporation. They are Henry A. Poppert, Russell L. Poppert and Jacob J. Poppert Jr.

New Trade Publications

AIR PURIFIER—The Industrial Air Engineering Co., Elyria, O., has published an 8-page illustrated bulletin in which an air purifier and dust collector is described and illustrated. The purifier consists of an airtight steel housing, divided into two chambers. The upper chamber holds the air purifying bags, and the lower acts as a dust collector. In the upper chamber a suction is created by means of an exhaust fan of proportions to suit the installation. This suction is transmitted to the dust pipe, which is connected to the chamber below a wooden frame, which holds the open bottom end of the air purifying bags. This suction in the dust pipes carries all the dust away from where it is generated into the lower chamber, where the heavier particles drop out of the air current into the hoppers and the finer particles follow the air current into the bags, where they are arrested and the air purified. Other details are given.

SANDBLAST ROOMS—The Industrial Air Engineering Co., Elyria, O., is circulating a 14-page illustrated booklet in which sandblast rooms and equipment are described and illustrated. The information given is interesting and valuable.

STEEL SASH—The Truscon Steel Co., Detroit, has published an 80-page illustrated booklet, which is one of the most complete works on steel window sash to be published. Standard dimension tables, architectural details, specifications and more than 20 pages of illustrations feature the booklet. Distinctive features of the sash are pointed out and installation details given. The booklet is divided into five parts, each part devoted to describing some particular type of this sash. The first part gives a general outline of the features; the second section is devoted to continuous types; the third to torsion type for pivoted sidewall sash and tension type for continuous sash; the fourth to counterbalanced types and the fifth to partitions and doors.

INSULATION.—A small folder has been published by the Armstrong Cork & Insulation Co., Pittsburgh, in which the advantages of proper heating insulations are pointed out. The folder is illustrated, and the insulation material described is, according to the booklet, especially suited for use on vulcanizers, cookers and similar equipment whose insulation is frequently subjected to excessive quantities of steam or water.

PUMPS—The Dean Bros. Steam Pump Works, Indianapolis, has published a 68-page illustrated booklet in which duplex, double acting pumps are described and illustrated. All speeds, capacities, fittings, etc., are listed in the booklet, and numerous illustrations of various sizes and types are given.

REFRACTORY MATERIAL—The Quigley Furnace Specialties Co., New York, is circulating a 20-page illustrated bulletin in which the use of a refractory material in power plants is described. This material, according to the bulletin, is a plastic refractory material compounded for bonding fire brick, etc. It can be used as a binder wherever fire clay brick, silica brick, tile or granular refractories are used.

POWER LOSSES—The Uehling Instrument Co., Paterson, N. J., has published an 8-page booklet in which the power losses through heat escaping through the chimney are pointed out. According to the booklet, in ordinary practice, the heat loss ranges from 15 to 30 per cent of the heat contained in the fuel. Graphic illustrations show the importance of these losses as compared with other boiler losses. The booklet points out that only through the use of instruments and carefully kept records can the magnitude of these losses be found. The company is also circulating a second bulletin containing additional information on the chimney power loss subject.

CHAIN—The Howe Chain Co., Muskegon, Mich., has published a 96-page illustrated catalog in which chain for elevating, conveying and power transmission are described and illustrated. The chain shown in the catalog substantially covers all of those forms, sizes and attachments which are usually preferred in the successful handling of industrial engineering problems. All chain are standard in every essential. In addition to the specifications given, general information also is presented.

SNAP FLASKS—The American Foundry Equipment Co., New York, is circulating a 4-page circular in which snap flasks are described. These flasks are of cast aluminum. There are no open corners nor hinges and each section is cast in a solid rigid piece. When the mold is made, the cope and drag are lifted off together. Malleable sand strips carry the cope sand. The flasks are finished smooth and flanges are provided for adding hardwood extensions. These flasks are made in a variety of sizes and depths, rectangular and circular.

ELECTRIC HOISTS—The Northern Engineering Works, Detroit, has published a 14-page illustrated booklet in which several types of electric hoists are described and illustrated. The illustrations show the hoists handling castings, unloading coal from cars, handling paper, conveying molten iron, handling steel at dipping tanks, handling drop forgings, etc.

PULVERIZED COAL SYSTEM—The Bonnot Co., Canton, O., is circulating a 16-page illustrated booklet in which the use of a pulverized fuel system in annealing iron is described. According to the booklet, the operating performances of this system, as outlined, is based upon reports of exhaustive tests made by the Chicago Railway Equipment Co. This system of pulverized coal distribution, utilizes the carrying capacity of a stream of air in a pipe circuit to deliver the coal and part of the air required to the furnaces. It is claimed that this system does away with the need of coal storage bins, mechanical feeders and electrical equipment being in close proximity to the furnaces. The automatic regulating feature of the system, makes it only necessary for the furnace man to open or close the valves to secure and regulate his supply of fuel.

MECHANICAL HANDLING—Gifford-Wood Co., Hudson, N. Y., is circulating a 12-page illustrated bulletin in which mechanical handling installations at numerous industrial plants are illustrated. The installations shown include elevating and conveying machinery for handling coal, ashes, stone, sand, gravel, etc.; coal handling machinery, wagon loaders, locomotive coaling stations, pivoted bucket carriers, grain elevating machinery, warehouse conveyors, car unloaders, coal pockets, screens and chutes, clutches, hoists, etc.

GEAR CUTTING—The Fellows Gear Shaper Co., Springfield, Vt., has published a 32-page illustrated booklet in which a new type of gear shaper is described and illustrated. According to the booklet, the principle of operation of this new cutter is fundamentally the same as the standard gear shaper. The cutters used are standard, the teeth of which are generated with great precision after hardening. Owing to the high speed at which the cutter is operated, and the short stroke of the machine, ganging of gears, except for very thin gears, is entirely unnecessary. This new type gear shaper was designed to meet the requirements of those manufacturers having a large number of gears of one particular size to cut.

GRINDING MACHINE—The Cincinnati Grinder Co., Cincinnati, has published a 16-page illustrated booklet in which a grinding machine, especially developed for the automobile repair shop is described and illustrated. This tool is especially adapted to the grinding of internal combustion engine parts, such as crankshaft pins, bearings, valve seats, pistons, piston rings, valve stems, piston stems, push rods, and in fact all ground parts in the gasoline motor, with the exception of the cylinder. The machine is made in two styles, power feed and hand feed, and can be furnished for belt or motor drive. The power feed machine is fitted with such mechanisms as are necessary to provide power traverse and automatic reverse to the table and automatic in-feed to the grinding wheel. The hand feed machine, while of the same design as the power feed, is stripped of those units which provide traverse and automatic reverse to the table and automatic in-feed to the grinding wheel. A fast and slow hand traverse to the table has been added for truing the wheel.